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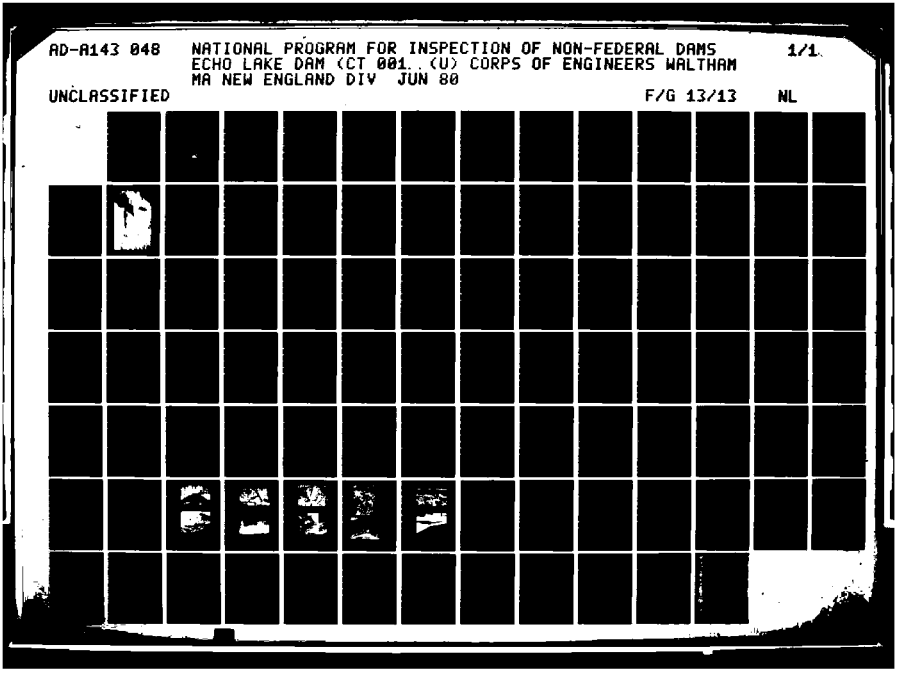

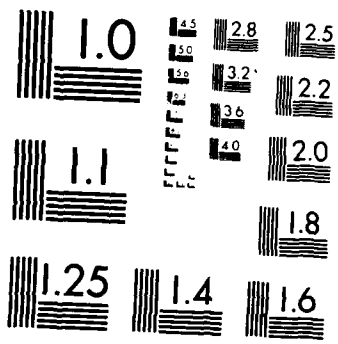

NAUGATUCK RIVER BASIN

WATERTOWN, CONNECTICUT

ECHO LAKE DAM
CT 00124

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JUNE 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Naugatuck River Basin
Watertown, Conn.
Echo Lake Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Echo Lake Dam consists of an earth embankment with a maximum height of 18 ft., a top width of 12 ft. and an overall length of 220 ft., including a 32 ft. wide bituminous concrete quxiliary spillway located near the left abutment. The main spillway consists of a morining glory type spillway located near the center of the dam. The outlet works consist of a 12-inch cast iron low level outlet or blow-off controlled by a manually operated gate valve located in the riser pipe of the morning glory type spillway. The dam impounds Echo Lake, which is used for swimming and fishing by residents of Watertown.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED-E

DEC 9 1980

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the Echo Lake Dam (CT-00124) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. The report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis. A brief assessment is included at the beginning of the report.

The preliminary hydrologic analysis has indicated that the spillway capacity for the Echo Lake Dam would likely be exceeded by floods greater than 39 percent of the Probable Maximum Flood (PMF), the test flood for spillway adequacy. Our screening criteria specifies that a dam of this class which does not have sufficient spillway capacity to discharge fifty percent of the PMF, should be adjudged as having a seriously inadequate spillway and the dam assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

The term "unsafe" applied to a dam because of an inadequate spillway does not indicate the same degree of emergency as that term would if applied because of structural deficiency. It does indicate, however, that a severe storm may cause overtopping and possible failure of the dam, with significant damage and potential loss of life downstream.

It is recommended that within twelve months from the date of this report the owner of the dam engage the services of a professional or consulting engineer to determine by more sophisticated methods and procedures the magnitude of the spillway deficiency. Based on this determination, appropriate remedial mitigating measures should be designed and completed within 24 months of this date of notification. In the interim a detailed emergency operation plan and warning system should be promptly developed. During periods of unusually heavy precipitation, round-the-clock surveillance should be provided.

DEC 9 1980

NEDED-E
Honorable Ella T. Grasso

I have approved the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of the non-Federal Dam Inspection Program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. This report has also been furnished to the owner of the project, the town of Watertown.

Copies of this report will be made available to the public, upon request to this office, under the Freedom of Information Act, thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for the cooperation extended in carrying out this program.

Sincerely,

WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting Division Engineer

ECHO LAKE DAM
CT 00124

NAUGATUCK RIVER BASIN
WATERTOWN, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

IDENTIFICATION NO: CT 00124

NAME OF DAM: Echo Lake Dam

TOWN: Watertown

COUNTY AND STATE: Litchfield County, Connecticut

STREAM: Echo Lake Brook

DATE OF INSPECTION: May 2, 1980

BRIEF ASSESSMENT

The Echo Lake Dam consists of an earth embankment with a maximum height of 18 feet, a top width of 12 feet and an overall length of 220 feet, including a 32 foot wide bituminous concrete auxiliary spillway located near the left abutment. The main spillway consists of a morning glory (drop inlet) type spillway located near the center of the dam. The outlet works consist of a 12-inch cast iron low level outlet or blowoff controlled by a manually operated gate valve located in the riser pipe of the morning glory type spillway.

The dam impounds Echo Lake, which is used for swimming and fishing by residents of Watertown.

Based on the visual inspection, the dam is judged to be in poor condition. Features that could affect the future integrity of the dam are continued erosion of the upstream and downstream slopes, seepage through the dam, and continued deterioration of the auxiliary spillway.

The dam is classified as "Small" in size, with a "High" hazard potential. A Test Flood equal to one-half the Probable Maximum Flood (1/2 PMF) was selected in accordance with the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams. The Test Flood inflow is 615 cfs and the Test Flood routed outflow is 510 cfs, overtopping the dam by 0.1 feet.

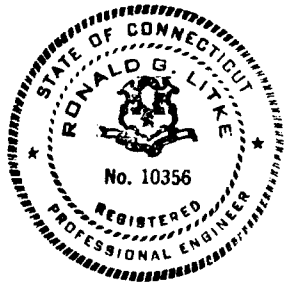
The auxiliary spillway capacity with the water level at the top of the dam is 400 cfs and is equal to 78 percent of the Test Flood routed outflow. The capacity of the morning glory type spillway was neglected because of the potential for clogging.

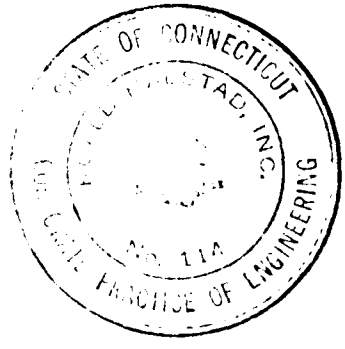
It is recommended that a qualified, registered engineer be retained to investigate the erosion of the upstream and downstream slopes, the seepage through the dam, the deterioration of the auxiliary spillway, the removal of trees from the embankment; and to perform a detailed hydrologic and hydraulic analysis. In addition, the dam should be inspected annually by a qualified, registered engineer, an operations and maintenance manual should be prepared and a formal warning system put into effect.

The owner should implement these recommendations as described herein and in greater detail in Section 7 of the Report within one year after receipt of this Phase I Inspection Report.

Ronald G. Litke, P.E.
Project Engineer

Roald Haestad
President





This Phase I Inspection Report on Echo Lake Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the

condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety of the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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OVERVIEW PHOTO

U S ARMY ENGINEER DIV NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

ROALD HAESTAD, INC.
CONSULTING ENGINEERS
WATERBURY, CONNECTICUT

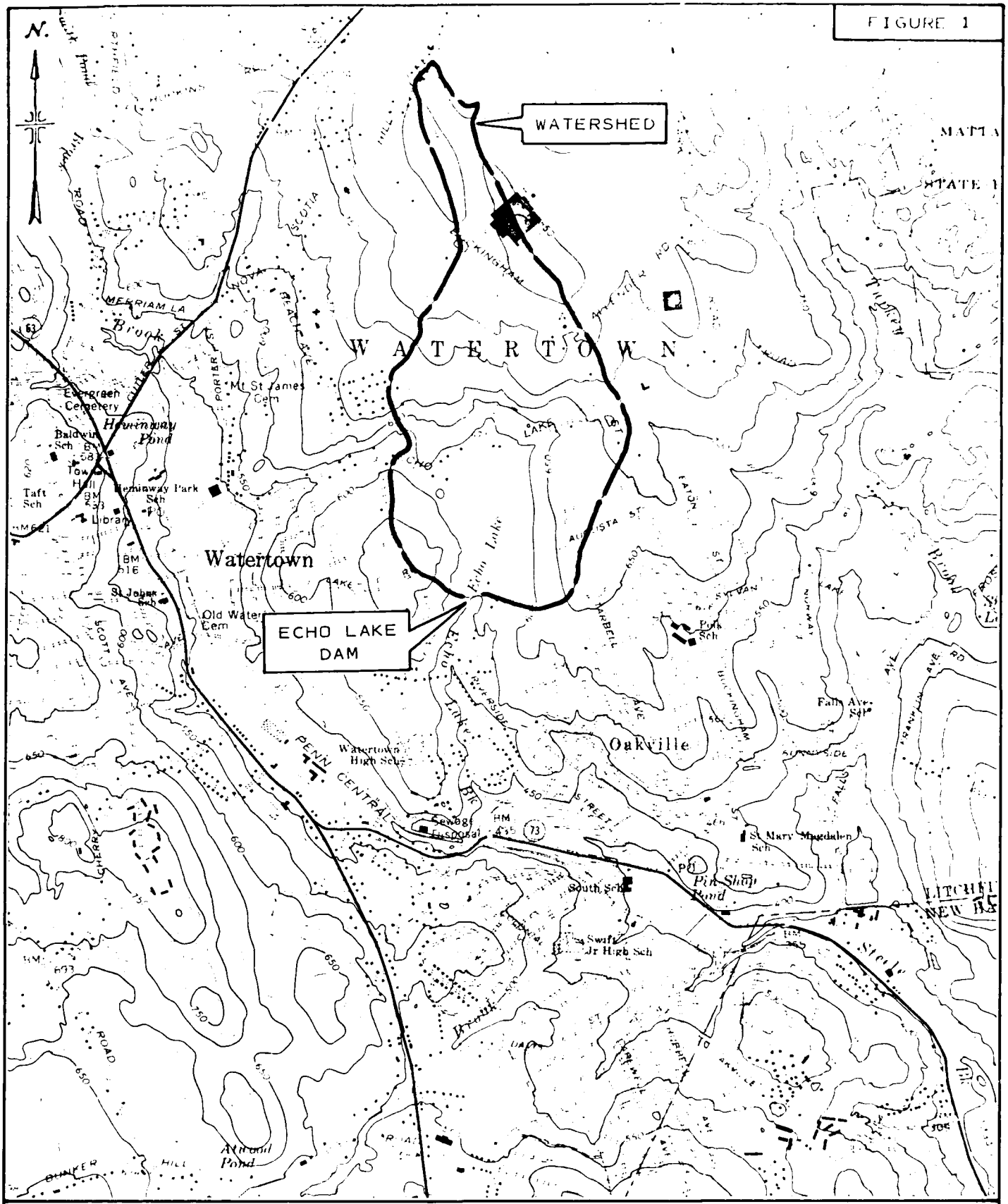
NATIONAL PROGRAM OF
INSPECTION OF
NON-FED. DAMS

ECHO LAKE DAM - CT00124

ECHO LAKE BROOK

WATERTOWN, CONNECTICUT DATE: 19 APRIL '80

FIGURE 1



LOCATION PLAN

ECHO LAKE DAM
WATERTOWN, CONNECTICUT

SCALE: 1" = 2000'

ROALD HAESTAD, INC. WATERBURY QUADRANGLE 1972

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

PROJECT INFORMATION
SECTION 1

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Roald Haestad, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Roald Haestad, Inc., under a letter of April 14, 1980, from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0048 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

The purposes of the program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interest.
2. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.
3. To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

The Echo Lake Dam is located on Echo Lake Brook approximately 4,500 feet east of Connecticut Route 63 and approximately 3,500 feet north of Connecticut Route 73 in the Town of Watertown, Connecticut. The dam is shown on the Waterbury U.S.G.S. Quadrangle Map having coordinates of latitude N 41° 36.0' and longitude W 73° 05.9'.

b. Description of Dam and Appurtenances

The dam consists of an earth embankment with a maximum height of 18 feet, a top width of 12 feet, an upstream slope of 3 horizontal to 1 vertical, and a downstream slope of 2 horizontal to 1 vertical. There is no slope protection present on the upstream slope. The downstream slope is covered with small brush and grass. The overall length of the dam is 220 feet including a 32 foot long auxiliary spillway located near the left abutment of the dam. The auxiliary spillway is constructed of bituminous concrete over a gravel base and has a riprapped discharge channel. The main spillway is a morning glory (drop inlet) type located near the water's edge approximately 40 feet to the right of the auxiliary spillway. The spillway consists of a 48-inch cast iron grate mounted on the top of a 36-inch reinforced concrete riser pipe. A 24-inch reinforced concrete outlet pipe extends from the riser pipe to a concrete endwall at the downstream toe of the dam. The presence of the grate on this type of spillway makes it susceptable to clogging. The 36-inch riser pipe also serves as a gate chamber for a 12-inch low level outlet or blowoff which also discharges through the 24-inch outlet pipe.

c. Size Classification - "Small"

According to the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, a dam is classified as "Small" in size if the height is between 25 feet and 40 feet, or the dam impounds between 50 Acre-Feet and 1,000 Acre-Feet of water. The dam has a maximum height of 18 feet and a maximum storage capacity of 121 Acre-Feet. Therefore, the dam is classified as "Small" in size based upon the storage capacity of 121 Acre-Feet.

d. Hazard Classification - "High"

Based upon the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the hazard classification of Echo Lake Dam is "High". A dam failure analysis indicates that 10 houses located downstream of the dam would be effected in the event of a dam breach, possibly resulting in the loss of more than a few lives.

Based on the maximum project discharge of 470 cfs, the depth of flow in the stream in the area of the houses prior to dam breach would be about 4.5 feet, or 3 feet below the basement floors. The depth of flow in this area due to the dam breach would be 12.5 feet or 5 feet above the elevation of the basement floors.

e. Ownership

Former Owner: Unknown

Present Owner: Town of Watertown
James Troup, Town Manager
Town Hall Annex
Main Street
Watertown, Connecticut 06795
(203) 274-5411

f. Operator

William B. Owen, P.E.
Director of Public Works
Town Hall Annex
Main Street
Watertown, Connecticut 06795
(203) 274-5411

g. Purpose of Dam

The dam impounds Echo Lake, which is used for swimming and fishing by the residents of Watertown.

h. Design and Construction History

The dam was originally constructed as a stone masonry structure with an upstream earth embankment. In 1957 a portion of the dam was purposely breached to allow for the removal of sediment from the impoundment. In 1958, the breached portion of the dam was repaired and a new outlet pipe installed. On October 1, 1958, on its first filling the dam failed before the water reached spillway level. In 1959 the dam was again repaired, this time by replacing the breached portion with an earth embankment, and installing a morning glory type spillway, new outlet works and a bituminous concrete auxiliary spillway.

i. Normal Operational Procedures

The low level outlet or blowoff is normally operated several times a year, usually after a storm, to maintain a constant water level for swimming. The inlet grate to the morning glory type spillway is cleaned as required.

1.3 Pertinent Data

a. Drainage Area

The drainage area consists of 0.58 square miles of wooded, "rolling" terrain with some residential and commercial development.

b. Discharge at Damsite

Water normally discharges into a 48-inch diameter morning glory (drop inlet) type spillway and through a 24-inch RCP outlet pipe. A 32 foot auxiliary spillway is 0.6 feet higher in elevation. The outlet works consist of a 12-inch cast iron pipe discharging into the spillway riser pipe.

1.	Outlet Works (conduits) Size:	12 inch
	Invert Elevation @ Outlet:	535.2
	Discharge Capacity:	14 cfs
2.	Maximum Known Flood at Damsite:	Unknown
3.	Ungated Spillway Capacity* at Top of Dam:	470 cfs
	Elevation:	553
4.	Ungated Spillway Capacity* at Test Flood Elevation:	495 cfs
	Elevation:	553.1
5.	Gated Spillway Capacity at Normal Pool Elevation:	N/A
	Elevation:	N/A
6.	Gated Spillway Capacity at Test Flood Elevation:	N/A
	Elevation:	N/A
7.	Total Spillway Capacity* at Test Flood Elevation:	495 cfs
	Elevation:	553.1
8.	Total Project Discharge* at Top of Dam:	470 cfs
	Elevation:	553
9.	Total Project Discharge** at Test Flood Elevation:	510 cfs
	Elevation:	553.1

*Spillway capacity = Main Spillway + Auxiliary Spillway
**Does not include main spillway.

c. Elevation - Feet Above Mean Sea Level (NGVD)

1. Streambed at Toe of Dam:	535
2. Bottom of Cutoff:	533±
3. Maximum Tailwater:	N/A
4. Recreation Pool:	550
5. Full Flood Control Pool:	N/A
6. Spillway Crest:	550
7. Design Surcharge - Original Design:	Unknown
8. Top of Dam:	553
9. Test Flood Surcharge:	553.1

d. Reservoir - Length in Feet

1. Normal Pool:	1,500'
2. Flood Control Pool:	N/A
3. Spillway Crest Pool:	1,500'
4. Top of Dam:	1,500'
5. Test Flood Pool:	1,500'

e. Storage - Acre-feet

1. Normal Pool:	88 Acre-Feet
2. Flood Control Pool:	N/A
3. Spillway Crest Pool:	88 Acre-Feet
4. Top of Dam:	121 Acre-Feet
5. Test Flood Pool:	122 Acre-Feet

f. Reservoir Surface - Acres

1. Normal Pool:	11 Acres
2. Flood-Control Pool:	N/A
3. Spillway Crest:	11 Acres
4. Test Flood Pool:	11 Acres
5. Top of Dam:	11 Acres

g. Dam

1.	Type:	Earth Embankment
2.	Length:	220'
3.	Height:	18'
4.	Top Width:	12'
5.	Side Slopes:	Upstream - ? Horiz. to 1 Vert. Downstream - ? Horiz. to 1 Vert.
6.	Zoning:	Unknown
7.	Impervious Core:	Impervious material with 1:1 slope upstream and 1:5 slope downstream in portion of dam that breached.
8.	Cutoff:	Concrete cutoff 2'± below 24-inch outlet pipe
9.	Grout Curtain:	N/A
10.	Other:	

h. Diversion and Regulating Tunnel N/A

i. Spillway	Main	Auxiliary
1. Type:	Morning Glory (Drop Inlet) Type	Broad-crested Bituminous Concrete Weir
2. Length of Weir:	4' Diameter Inlet Grate	32'
3. Crest Elevation with Flashboards:	N/A	N/A
without Flashboards:	550	550.6
4. Gates:	N/A	N/A
5. Upstream Channel:	N/A	N/A
6. Downstream Channel:	Natural Streambed	Riprap Discharge Channel to Natural Stream
7. General:	Capacity = 70 cfs with water level at top of dam	Capacity = 400 cfs with water level at top of dam

j. Regulating Outlets	
1. Invert:	535.2 @ Outlet of 24" RCP
2. Size:	12"
3. Description:	Cast iron pipe from upstream toe to riser pipe of morning glory type spillway. Discharges through 24" RCP outlet.
4. Control Mechanism:	Manually operated gate valve in spillway riser pipe
5. Other:	Capacity 14 cfs

ENGINEERING DATA

SECTION 2

2.1 Engineering Data

Available information which was reviewed included a set of Plans for the repairs to the dam following the October 1, 1958 failure. The plans were prepared by Clarke and Pearson, Civil Engineers, Ansonia, Connecticut. Other information included newspaper articles and photographs of the failure, numerous pieces of correspondence regarding the dam, and a committee report made to the Superior Court of Litchfield County regarding the failure.

2.2 Construction Data

The only construction information available for review were the above-noted plans of the repairs and the committee report on the failure. The contractor for the reconstruction of the intentional breach and for the repairs following the failure was Innes Brothers, Inc., of Thomaston, Connecticut. Drawings and specifications for the original reconstruction were referred to in the Superior Court Committee Report, but were unavailable for review.

2.3 Operation Data

There was no operation data on the dam available for review.

2.4 Evaluation of Data

a. Availability

Existing data was provided by the Town of Watertown, Clarke and Pearson, Civil Engineers, and the State of Connecticut, Department of Environmental Protection.

b. Adequacy

The information which was available, along with the visual inspection, and the hydrologic and hydraulic calculations made for this report, were adequate to assess the condition of the dam.

c. Validity

Field inspections and surveys revealed that the dam was constructed substantially as shown on the plans for the repairs. A cast iron grate is present on the morning glory type spillway, as opposed to the floating wood grate shown on the plans. The low level outlet or blowoff gate is located inside the riser pipe for the morning glory type spillway, and not upstream of the riser as shown on the plans.

VISUAL INSPECTION

SECTION 3

3.1 Findings

a. General

The visual inspection of the dam was conducted on May 2, 1980. At the time of inspection the water level was approximately 0.05 feet above the morning glory type spillway. The general condition of the dam at the time of inspection was poor.

The dam consists of an earth embankment with a morning glory type spillway located near the center of the dam, and an auxiliary spillway located near the left abutment.

b. Dam

The upstream slope of the dam has no riprap slope protection, Photo 1. Just above the water level there appears to be a slight depression of the upstream slope in the vicinity of the morning glory type spillway.

The crest of the dam slopes toward the lake and has very little vegetation on it, Photo 1. The surface has a slight undulating appearance with the area near the right abutment being lower in elevation than the area near the morning glory type spillway.

The downstream slope is covered with grass and brush, Photo 2. Numerous animal burrows up to 6 inches in diameter, three large trees and several stumps up to 4 inches in diameter were present on the downstream slope. A 12 inch wide erosion path has developed from the crest to the concrete endwall at the toe of the downstream slope, Photo 3. Another erosion path was also observed to the right of the concrete endwall. Considerable erosion has occurred around the

concrete endwall for the outlet pipe, Photo 4. A small hole, approximately 7 inches in diameter and 12 inches deep, was observed just upstream of the concrete endwall, Photo 5. Seepage was observed exiting from the toe of the downstream slope near the right end of the concrete endwall, Photo 6. The area was rust-colored and flow was free of sediments at the time of inspection.

A wet and spongy area approximately 20 feet wide was observed adjacent to the downstream toe, Photo 2. The area contains moisture-loving vegetation and extends approximately 50 feet downstream. A small amount of clear seepage with rust-colored floccules was observed flowing from the ground approximately 60 feet downstream of the toe, Photo 7.

c. Appurtenant Structures

The appurtenant structures consist of the morning glory type spillway, the auxiliary spillway and the outlet works.

The morning glory type spillway consists of a 48-inch diameter inlet grate on a 36-inch reinforced concrete pipe riser. The grate is susceptable to clogging with debris, Photo 8. The outlet works consist of a 12-inch cast iron pipe from the upstream toe discharging into the morning glory type spillway riser pipe and controlled by a manually operated gate located in the riser pipe. The gate was reported to be operable. A 24-inch reinforced concrete discharge pipe from the riser, through the dam, outlets at a concrete endwall at the downstream toe, Photo 4.

The emergency spillway consists of a broad crested weir constructed of bituminous concrete, Photo 1. The bituminous concrete has been extensively cracked and eroded along the downstream slope,

Photos 2 and 9. A large amount of crushed stone and small boulders have been placed on the slope in an attempt to stabilize the area from further erosion.

At the left abutment water was flowing from an underdrain into the spillway discharge channel. The water flowed under the stone and appeared at the surface near the toe. See Figure 2, page B-1 in Appendix B.

d. Reservoir Area

It appears that a portion of the beach has encroached on the upstream side of the auxiliary spillway, Photo 10. No other indications of instability along the edges of the reservoir in the vicinity of the dam were noted.

e. Downstream Channel

The downstream channel consists of a natural streambed. The channel bottom is covered with small boulders and gravel. Some trees were observed overhanging the channel.

3.2 Evaluation

On the basis of the visual inspection the dam is judged to be in poor condition. The following features could affect the future integrity of the dam:

1. Continued erosion of the upstream slope above the water level due to the absence of riprap could lead to a reduction of freeboard.

2. The erosion and seepage in the vicintiy of the concrete endwall could lead to internal erosion of the dam.

3. The seepage associated with the wet and spongy area along the toe and downstream of the dam could lead to piping and internal erosion in the future. Some seepage was observed near the outlet channel 60 feet downstream from the dam.

4. The root systems of the trees and brush on the earth embankment could provide future seepage paths through the embankment. The large trees could also uproot during a storm and cause damage to the embankment.

5. The deterioration of the auxiliary spillway channel downstream of the dam could eventually cause a breach of the dam.

6. The depression of the upstream slope in the vicinity of the morning glory type spillway may be the result of several causes including erosion of the slope due to vortex action around the spillway inlet, wave action, trespassers, or the possibility of internal erosion adjacent to the conduit through the dam.

7. Animal burrows and erosion paths on the downstream slopes could lead to the continued deterioration of the embankment.

OPERATIONAL AND MAINTENANCE PROCEDURES

SECTION 4

4.1 Operational Procedures

a. General

The low level outlet or blowoff is normally operated several times a year, usually after a storm, to maintain a constant water level for swimming.

b. Description of Any Warning System In Effect

There is no formal warning system in effect.

4.2 Maintenance Procedures

a. General

Normal maintenance procedures consist of clearing brush on the downstream slope periodically, and stabilizing the auxiliary spillway discharge channel with riprap when required.

b. Operating Facilities

The inlet grate on the morning glory type spillway is cleared of debris regularly.

4.3 Evaluation

Present operations and maintenance procedures are inadequate, as is evident by the condition of the auxiliary spillway and the crest of the dam.

An operation and maintenance manual should be prepared for the dam and operating facilities, and a formal warning system put into effect. In addition, the dam should be inspected annually by a qualified, registered engineer.

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

SECTION 5

5.1 General

The spillway at Echo Lake Dam is a morning glory (drop inlet) type spillway located near the center of the dam by the waters' edge. The spillway consists of a 36-inch reinforced concrete pipe (RCP) riser connected to a 24-inch RCP outlet pipe. See Figure 2, page B-1. The 36-inch riser pipe also serves as a gate chamber for a 12-inch low level outlet or blowoff which also discharges through the 24-inch outlet pipe. The morning glory type spillway has a 48-inch diameter cast iron grate on the top for safety reasons and to prevent debris from entering. On the left side of the dam is an auxiliary spillway 32 feet in length with sloping sides. The auxiliary spillway consists of a broad crested bituminous concrete section, about 0.6 feet above the morning glory type spillway, and a downstream riprapped discharge channel. The crest of the dam is 3.0 feet above the morning glory type spillway and 2.4 feet above the auxiliary spillway.

The capacity of the morning glory type spillway is 70 cfs with the water level at the top of the dam. The auxiliary spillway has a capacity of 400 cfs. The low level outlet or blowoff has a capacity of 14 cfs with the water level at the top of the dam.

The dam has a watershed of 0.58 square miles of wooded, "rolling" terrain with some residential and commercial development. The watershed has a maximum elevation of 860 at the north edge and an elevation of 550 at the spillway.

5.2 Design Data

Plans for the 1959 reconstruction were available and reviewed. No design computations were found.

5.3 Experience Data

The Echo Lake Dam was breached in 1957 in order to allow dredging of the pond. A new low level outlet pipe was installed during the reconstruction. On October 1, 1958, during the first filling after reconstruction, the dam failed in the vicinity of the new outlet pipe. Newspaper articles indicated that the resulting flood caused damage to 10 - 12 homes and washed out 2 roads. While some flooding of ground-floor living areas was reported, most damage to the homes was confined to flooded cellars, washed-out yards and undermined foundations. No injuries were reported as a result of the dam breach. The dam was rebuilt in 1959. No records of spillway flows have been kept. Erosion of the asphalt spillway has been a continuing problem and several repairs have been made.

5.4 Test Flood Analysis

Based on the dam failure analysis, the dam is classified as "High" hazard potential. The size of the dam is "Small", based on a height of 18 feet and storage capacity of 121 Acre-Feet. According to the Recommended Guidelines for Safety Inspection of Dams, by the Corps of Engineers, the Test Flood should be in the range of 1/2 the Probable Maximum Flood (1/2 PMF) to the full PMF. A Test Flood equal to the 1/2 PMF was selected because the low height of the dam and the storage capacity of only 121 Acre-Feet are in the lower range for a "Small" dam. The Test Flood inflow was calculated for the 0.58 square mile watershed using 2,125 cubic feet per second per square mile (csm) from the guide curve for "rolling" terrain supplied by the Corps of

Engineers for the PMF.

The 1/2 PMF peak inflow, calculated to be about 615 cfs, results in a routed outflow of 510 cfs. The flood routing through the reservoir was done in accordance with "Estimating Effect of Surcharge Storage on Maximum Probable Discharges" provided by the Corps of Engineers. In calculating the percent of the Test Flood that could be safely discharged, the morning glory type spillway was neglected because of the potential for clogging. The auxiliary spillway capacity was calculated to be 400 cfs or 78 percent of the Test Flood routed outflow which would overtop the dam by 0.1 feet.

5.5 Dam Failure Analysis

A dam failure analysis was made using the "Rule of Thumb" guidance provided by the Corps of Engineers. Failure was assumed when the water level reached the top of the dam.

The dam breach would release up to 5,900 cfs into the brook below the dam. The flood wave would travel 1,200 feet downstream where it would overtop French Street by about 6 feet. The flow would divide at this point with most of the water crossing the road and continuing down the brook and the remainder flowing down Riverside Street.

The water flowing down Riverside Street would eventually flow between the homes located to the right and back into the brook. The flood waters would continue downstream overtopping Tower Road by about 6 feet before discharging into Steele Brook 1,400 feet further downstream.

The maximum project discharge capacity of 470 cfs would overtop French Street and Tower Road by 0.6 and 0.1 feet respectively. Based on this discharge the depth of flow prior to dam breach in the area

of the affected houses on Riverside Street would be about 4.5 feet or 3 feet below the basement floors. After dam breach the depth of flow in this area would be about 12.5 feet or 5 feet deep in the basements of 8 houses. In the area of Tower Road the water due to the dam breach would be 3 feet below the sill elevation of one house and reach the sill elevation of a second house.

The dam is therefore classified as "High" hazard potential. A dam failure could result in the loss of more than a few lives, economic losses associated with the flooding of homes and damage to Town roads.

EVALUATION OF STRUCTURAL STABILITY

SECTION 6

6.1 Visual Observations

The visual inspection did not disclose any indications of immediate structural instability. The future integrity of the dam could be affected by the visual observations noted in Section 3.2.

6.2 Design and Construction Data

The only design and construction data available for this dam is a set of Plans for the repairs following the October 1, 1958 failure.

6.3 Post-Construction Changes

The correspondence indicates that the dam was breached in 1957 by the Watertown Park Commission in order to drain the lake and remove sediments from the impoundment. In May 1958, the breach was reconstructed in accordance with certain drawings and specifications which were not available for review. On its first filling, the dam failed before the water reached spillway level. Later testimony gathered by a special engineering committee convened by the Superior Court of Litchfield County indicated the contractor had placed a 3 foot thick clay blanket adjacent to the downstream vertical dry stone masonry wall. The testimony suggests that the presence of this clay blanket contributed to the failure of the dam. The failure zone in the dam was repaired in 1959. Plans for the repairs were prepared by Clarke and Pearson, Civil Engineers, Ansonia, Connecticut.

6.4 Seismic Stability

The dam is located in Seismic Zone 1 and in accordance with the recommended Phase I Inspection guidelines does not warrant seismic stability analysis.

7.1 Dam Assessment

a. Condition

On the basis of the visual inspection and a review of available data, the dam is judged to be in poor condition. The future integrity of the dam could be affected by continued erosion of the upstream and downstream slopes, seepage exiting from the vicinity of the concrete endwall and downstream of the dam, extensive vegetation and numerous animal burrows on the downstream slope and continued deterioration of the auxiliary spillway.

An evaluation of the hydraulic and hydrologic features of the dam determined that the auxiliary spillway is capable of passing 78 percent of the Test Flood routed outflow (1/2 PMF).

b. Adequacy of Information

The information available was sufficient for performing a Phase I Inspection.

c. Urgency

The recommendations presented in Section 7.2 and 7.3 should be carried out within one year of receipt of this report by the owner.

7.2 Recommendations

The following recommendations should be carried out under the direction of a qualified, registered engineer:

1. Erosion protection on the upstream slope of the earth embankment should be designed and constructed.

2. The erosion and seepage exiting from the vicinity of the concrete endwall should be investigated and erosion and seepage control measures designed and constructed.

3. The wet and spongy area along the toe and immediately downstream of the dam should be investigated and seepage control measures designed and constructed, as necessary.

4. The trees and stumps on the earth embankment sections of the dam and within 20 feet of the downstream toe should be removed. The root zones should be carefully backfilled with selected soil, as directed by the engineer.

5. The deterioration along the downstream channel of the auxiliary spillway should be investigated and remedial measures to prevent the undermining of the spillway slab should be designed and constructed.

6. The depression on the upstream slope in the vicinity of the morning glory type spillway should be investigated and remedial measures performed, as necessary.

7. A detailed hydraulic and hydrologic analsyis should be performed in order to determine the need for and means to provide additional project discharge capacity.

The owner should implement all recommendations made by the engineer based on the findings of the above investigations.

7.3 Remedial Measures

a. Operation and Maintenance Procedures

1. Institute a program of annual technical inspections by a qualified, registered engineer.

2. The animal burrows should be backfilled with a suitable material.

3. The brush should be removed from the downstream slope and the slope mowed periodically.

4. The sand which has accumulated upstream of the auxiliary spillway should be removed.

5. Erosion paths on the downstream embankment should be repaired.

6. A formal operations and maintenance manual for the dam and operating facilities should be prepared.

7. A formal warning system should be put into effect and include monitoring of the dam during extremely heavy rains, and procedures for notifying downstream authorities in the event of an emergency.

7.4 Alternatives

There are no practical alternatives to the above recommendations.

APPENDIX A

VISUAL CHECK LIST WITH COMMENTS

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT: Echo Lake Dam

DATE: 5/2/80 TIME: 11:00 a.m. 1:00 p.m. WEATHER: Cloudy - 55°

W.S. ELEVATION: 550.05 U.S. N/A DN.S
0.05 above spillway

	PARTY	DISCIPLINE
1.	Ronald G. Litke, P.E. - Roald Haestad, Inc.	Civil Engineer
2.	Donald L. Smith, P.E. - Roald Haestad, Inc.	Civil/Hydrologist
3.	Richard Murdock, P.E. - Geotechnical Engineers, Inc.	Geotechnical Engineer
4.		
5.		
6.		

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam Embankment	RM, RGL, DLS	Poor condition
2.	Outlet Works - Intake Channel and Intake Structure	RGL, DLS, RM	Morning Glory type spillway
3.	Outlet Works - Control Tower	RGL, DLS	Riser Pipe for Morning Glory type spillway
4.	Outlet Works - Transition and Conduit	RGL, DLS	Could not be observed
5.	Outlet Works - Outlet Structure and Outlet Channel	RGL, DLS	Good condition
6.	Outlet Works - Auxiliary Spwy. Weir, App. and Disch. Channels	RGL, DLS, RM	Poor condition
7.			
8.			
9.			
10.			
11.			
12.			

PERIODIC INSPECTION CHECK LIST

PROJECT: Echo Lake Dam DATE: [illegible]

PROJECT FEATURE: Dam Embankment NAME: EGL, DLM

DISCIPLINE: Civil and Geotechnical Engineers NAME: RM

AREA ELEVATION	CONDITIONS
DAM EMBANKMENT	
CREST ELEVATION	553
CURRENT POOL ELEVATION	550.05 (0.05' above spillway)
MAXIMUM IMPOUNDMENT TO DATE	Unknown
SURFACE CRACKS	None observed
PAVEMENT CONDITION	Crest is bare of vegetation.
MOVEMENT OR SETTLEMENT OF CREST	Apparent depression of upstream slope near intake conduit.
LATERAL MOVEMENT	None observed
VERTICAL ALIGNMENT	Too irregular to judge
HORIZONTAL ALIGNMENT	Too irregular to judge
CONDITION AT ABUTMENT AND AT CONCRETE STRUCTURES	Considerable deterioration of emergency spillway. Erosion adjacent to concrete endwall.
INDICATIONS OF MOVEMENT OF STRUCTURAL ITEMS ON SLOPES	None observed
TRESPASSING ON SLOPES	Several paths worn bare of vegetation on downstream slope.
VEGETATION ON SLOPES	Extensive vegetation on downstream slope and downstream of dam adjacent to the toe.
SLOUGHING OR EROSION OF SLOPES OR ABUTMENTS	Erosion of both upstream and downstream slopes.
ROCK SLOPE PROTECTION - RIPRAP FAILURES	No riprap present on upstream slope
UNUSUAL MOVEMENT OR CRACKING AT OR NEAR TOES	None observed
UNUSUAL EMBANKMENT OR DOWNSTREAM SEEPAGE	Seepage adjacent to concrete endwall and downstream of the toe.
PIPING OR BOILS	None observed
FOUNDATION DRAINAGE FEATURES	None observed
TOE DRAINS	None
INSTRUMENTATION SYSTEM	None

PERIODIC INSPECTION CHECK LIST

PROJECT: Echo Lake Dam DATE: 5/2/80

PROJECT FEATURE: Outlet Works - Intake Channel and Structure NAME: RGL

DISCIPLINE: Civil Engineers NAME: DLS

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
A. APPROACH CHANNEL:	Intake for blowoff is reported to be a 12" C.I. pipe from upstream toe to riser pipe of morning glory type spillway. Main spillway is morning glory drop inlet type with cast iron grate.
SLOPE CONDITIONS	N/A
BOTTOM CONDITIONS	N/A
ROCK SLIDES OR FALLS	N/A
LOG BOOM	N/A
DEBRIS	Debris tends to collect on grate.
CONDITION OF CONCRETE LINING	N/A
DRAINS OR WEEP HOLES	N/A
B. INTAKE STRUCTURE:	
CONDITION OF CONCRETE	Good
STOP LOGS AND SLOTS	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT: Echo Lake Dam DATE: 5/2/80

PROJECT FEATURE: Outlet Works - Control Tower NAME: RGL

DISCIPLINE: Civil Engineers NAME: DLS

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	Control Tower is reinforced concrete riser pipe of morning glory type spillway.
A. CONCRETE AND STRUCTURAL:	
GENERAL CONDITION	Good
CONDITION OF JOINTS	Could not be observed as water was spilling over
SPALLING	None observed
VISIBLE REINFORCING	None observed
RUSTING OR STAINING OF CONCRETE	None observed
ANY SEEPAGE OR EFFLORESCENCE	None observed
JOINT ALIGNMENT	N/A
UNUSUAL SEEPAGE OR LEAKS IN GATE CHAMBER	Could not be observed
CRACKS	None observed
RUSTING OR CORROSION OF STEEL	N/A
B. MECHANICAL AND ELECTRICAL:	
AIR VENTS	N/A
FLOAT WELLS	N/A
CRANE HOIST	N/A
ELEVATOR	N/A
HYDRAULIC SYSTEM	N/A
SERVICE GATES	Reported to be operable
EMERGENCY GATES	N/A
LIGHTNING PROTECTION SYSTEM	N/A
EMERGENCY POWER SYSTEM	N/A
WIRING AND LIGHTING SYSTEM IN GATE CHAMBER	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT: Echo Lake Dam DATE: 5/2/80

PROJECT FEATURE: Outlet Works - Transition & Conduit NAME: EGL

DISCIPLINE: Civil Engineers NAME: DLS

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	24" Reinforced Concrete Pipe
GENERAL CONDITION OF CONCRETE	None observed
RUST OR STAINING ON CONCRETE	
SPALLING	
EROSION OR CAVITATION	
CRACKING	
ALIGNMENT OF MONOLITHS	
ALIGNMENT OF JOINTS	
NUMBERING OF MONOLITHS	

PERIODIC INSPECTION CHECK LIST

PROJECT: Echo Lake Dam DATE: 5/2/80

PROJECT FEATURE: Outlet Works - Outlet Structure and Channel NAME: RGL

DISCIPLINE: Civil Engineers NAME: DLS

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	Outlet structure is concrete endwall for 24" RCP at downstream toe of dam
GENERAL CONDITION OF CONCRETE	Good
RUST OR STAINING	None observed
SPALLING	None observed, corners of endwall chipped
EROSION OR CAVITATION	None observed
VISIBLE REINFORCING	None observed
ANY SEEPAGE OR EFFLORESCENCE	Seepage at right end of wall
CONDITION AT JOINTS	N/A
DRAIN HOLES	None known
CHANNEL	Natural streambed
LOOSE ROCK OR TREES OVERHANGING CHANNEL	Some small trees overhanging channel
CONDITION OF DISCHARGE CHANNEL	Good

PERIODIC INSPECTION CHECK LIST

PROJECT: Echo Lake Dam DATE: 5/2/80

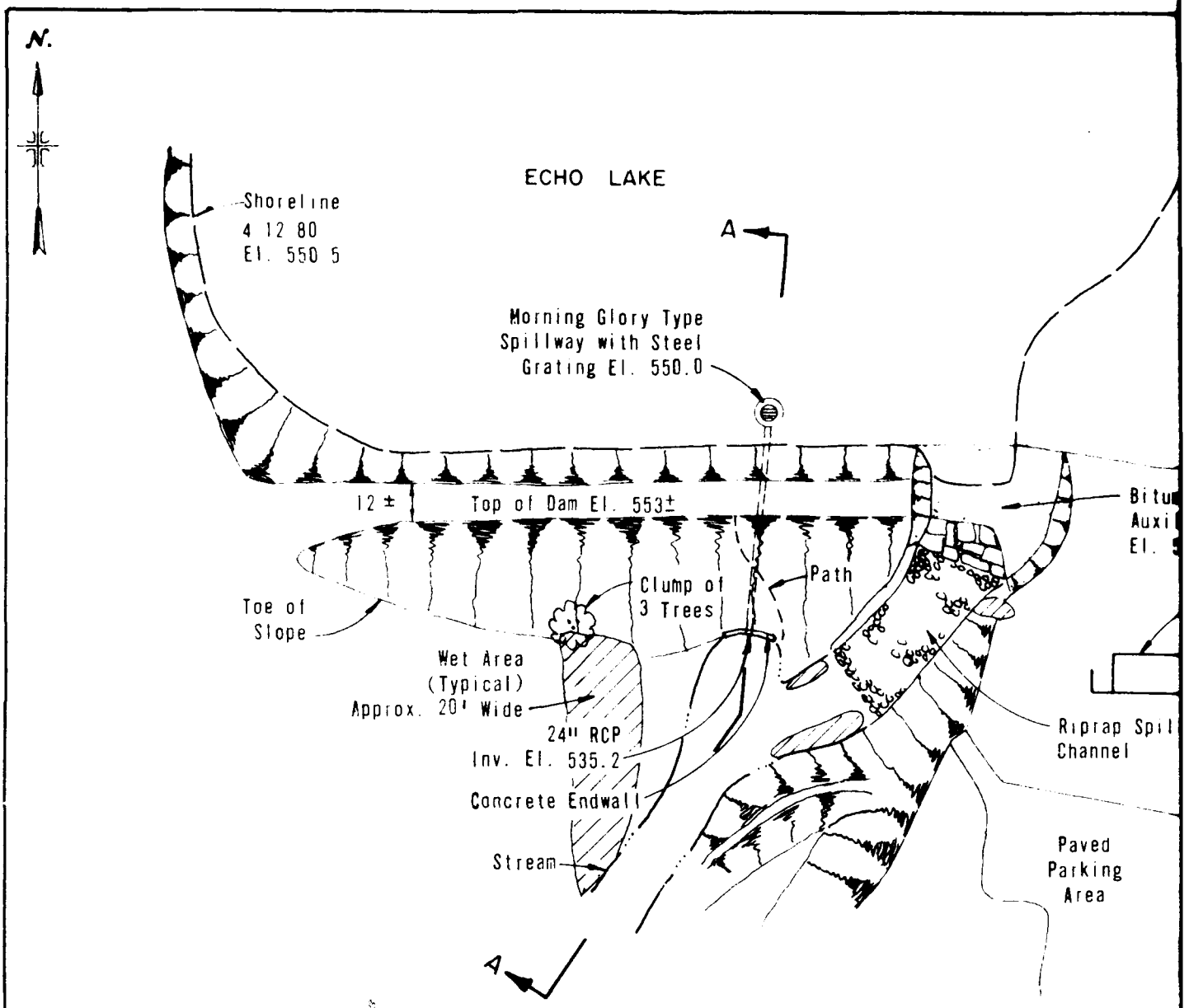
PROJECT FEATURE: Auxiliary Spillway Weir Outlet Works - App. & Disch. Channels NAME: RGL, DLS

DISCIPLINE: Civil and Geotechnical Engineers NAME: RM

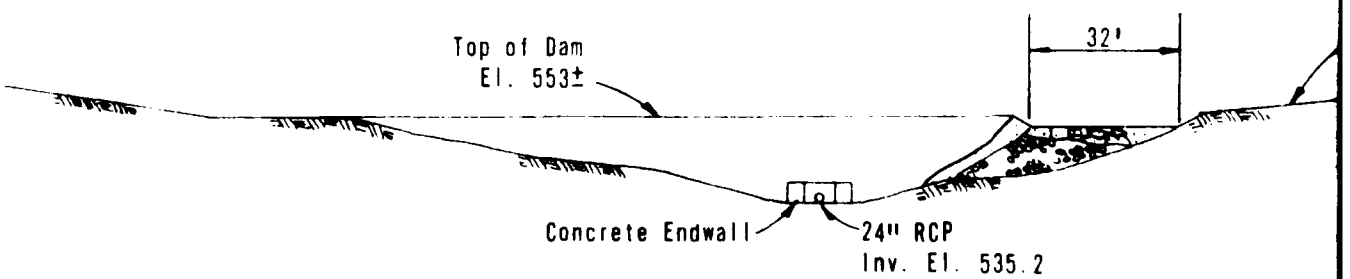
AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
A. APPROACH CHANNEL:	
GENERAL CONDITION	Fair, sand from beach encroaching on approach channel
LOOSE ROCK OVERHANGING CHANNEL	None
TREES OVERHANGING CHANNEL	None
FLOOR OF APPROACH CHANNEL	Grassed slope, no riprap protection
B. WEIR AND TRAINING WALLS:	Bituminous concrete approx. 2-1/2" thick over gravel base
GENERAL CONDITION OF CONCRETE	Bituminous concrete severely deteriorated in areas
RUST OR STAINING	N/A
SPALLING	N/A
ANY VISIBLE REINFORCING	N/A
ANY SEEPAGE OR EFFLORESCENCE	N/A
DRAIN HOLES	N/A
C. DISCHARGE CHANNEL:	
GENERAL CONDITION	Poor
LOOSE ROCK OVERHANGING CHANNEL	None
TREES OVERHANGING CHANNEL	Some trees present along left bank
FLOOR OF CHANNEL	Dumped stone riprap, severely deteriorated bituminous concrete
OTHER OBSTRUCTIONS	

APPENDIX B

ENGINEERING DATA



PLAN
Scale: 1" = 40'



ELEVATION
Scale: 1" = 40'

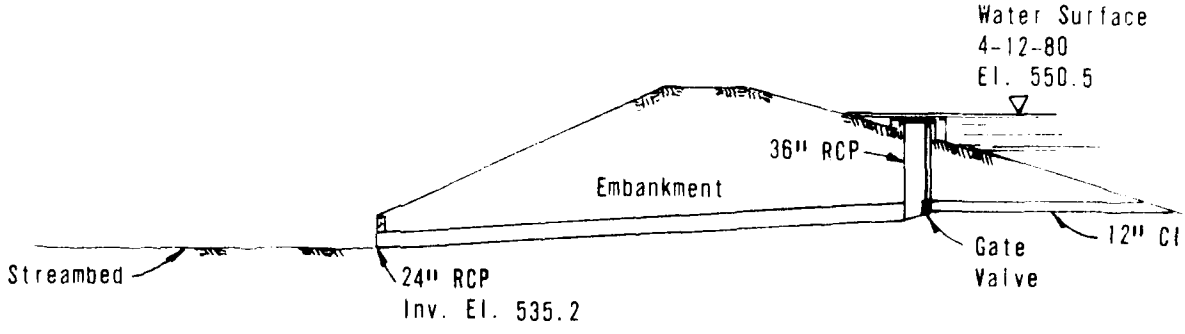
FIGURE 2

Beach Area

inous Concrete
iary Spillway
150 6±

Bath House

lway



SECTION A-A
Scale: 1" = 20'

Approximate Ground
Surface

ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT			U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS			
ECHO LAKE DAM			
DRAWN	CHECKED	APPROVED	SCALES AS NOTED
JRS	RGL	RH	DATE JUNE 1980 PAGE B-1

LIST OF REFERENCES

Reference No. 1 is located at the office of Clarke and Pearson, Civil Engineers, 435 East Main Street, Ansonia, Connecticut. The remaining references are located at the Department of Environmental Protection, Office of the Superintendent of Dams, State Office Building, Hartford, Connecticut.

1. Set of Drawings, "Plan of Proposed Repair to Echo Lake, Watertown, Connecticut", Clarke and Pearson, Civil Engineers, Ansonia. Connecticut.

2. Application for Construction Permit for Dam, Town of Watertown, Connecticut, 4/14/59.

3. Letter from Clarke and Pearson to Connecticut Water Resources Commission concerning raising top of dam to Elevation 51.0 and lowering Relief Spillway to Elevation 48.5.

4. Letter from Philip W. Genovese and Associates to Emmitt A. Dell, Water Resources Commission, concerning certificate of approval, with a copy of Committee Report to Superior Court of Litchfield County on Dam Failure.

5. Certificate of Approval from Connecticut Water Resources Commission, 7/10/61.

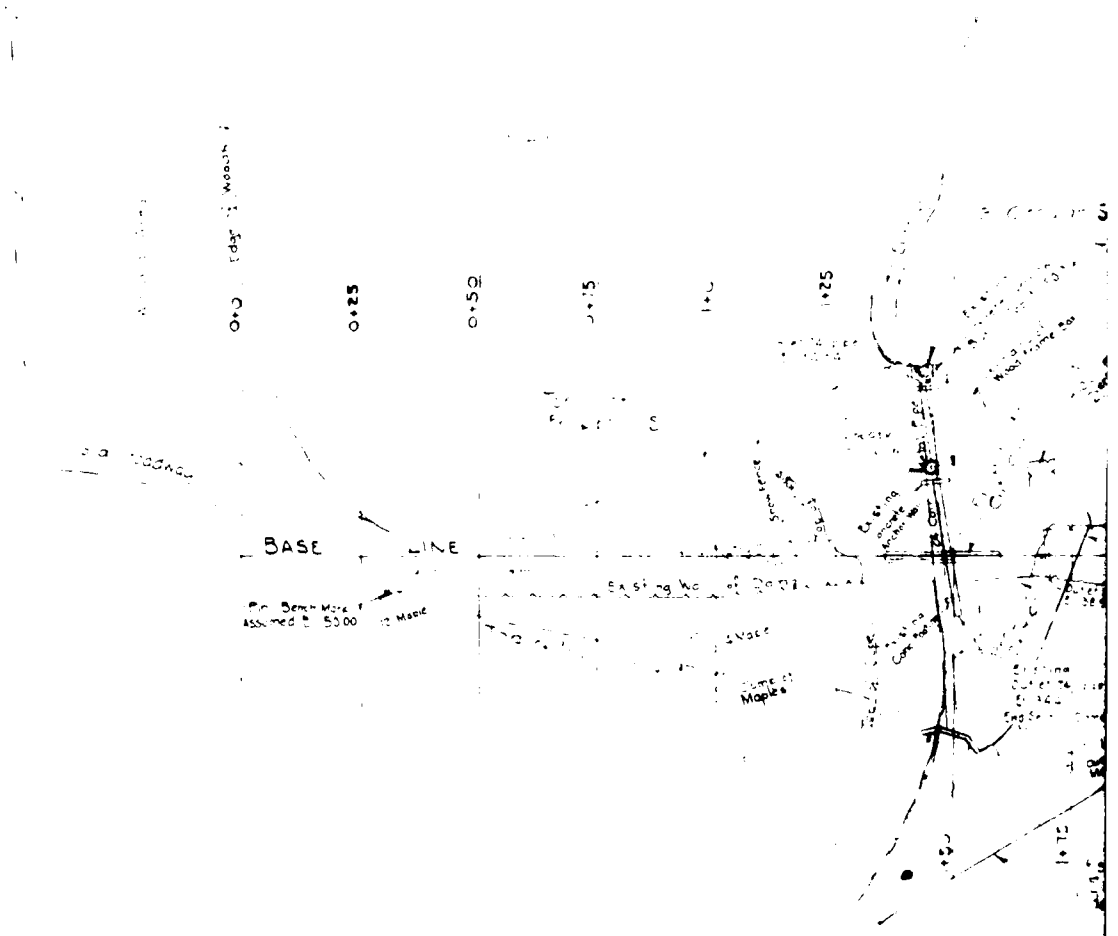
6. Various correspondence between Town of Watertown and State of Connecticut concerning clearing of brush from embankment and repairing erosion of auxiliary spillway, July 1975 through August 1977.

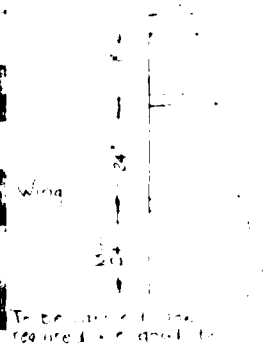
7. Newspaper Article and Photographs of Dam Failure.

8. Miscellaneous correspondence concerning dam.

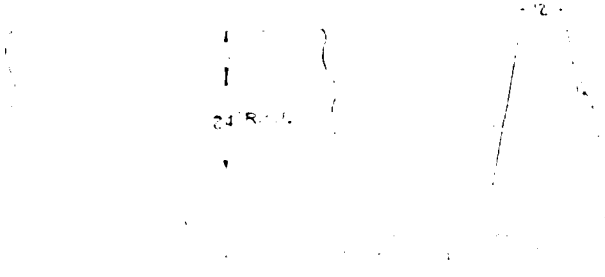
APPROXIMATE QUANTITIES

36" R.C. Pipe	[illegible]
24" R.C. Pipe	[illegible]
12" Cast Iron Pipe	[illegible]
2:4 Concrete	[illegible]
12" Gate	[illegible]
Floating Cover	[illegible]
Impervious Material	[illegible]
Fill	[illegible]
Gravel	[illegible]
Cut in Spillway	[illegible]
8:1 Concrete	[illegible]

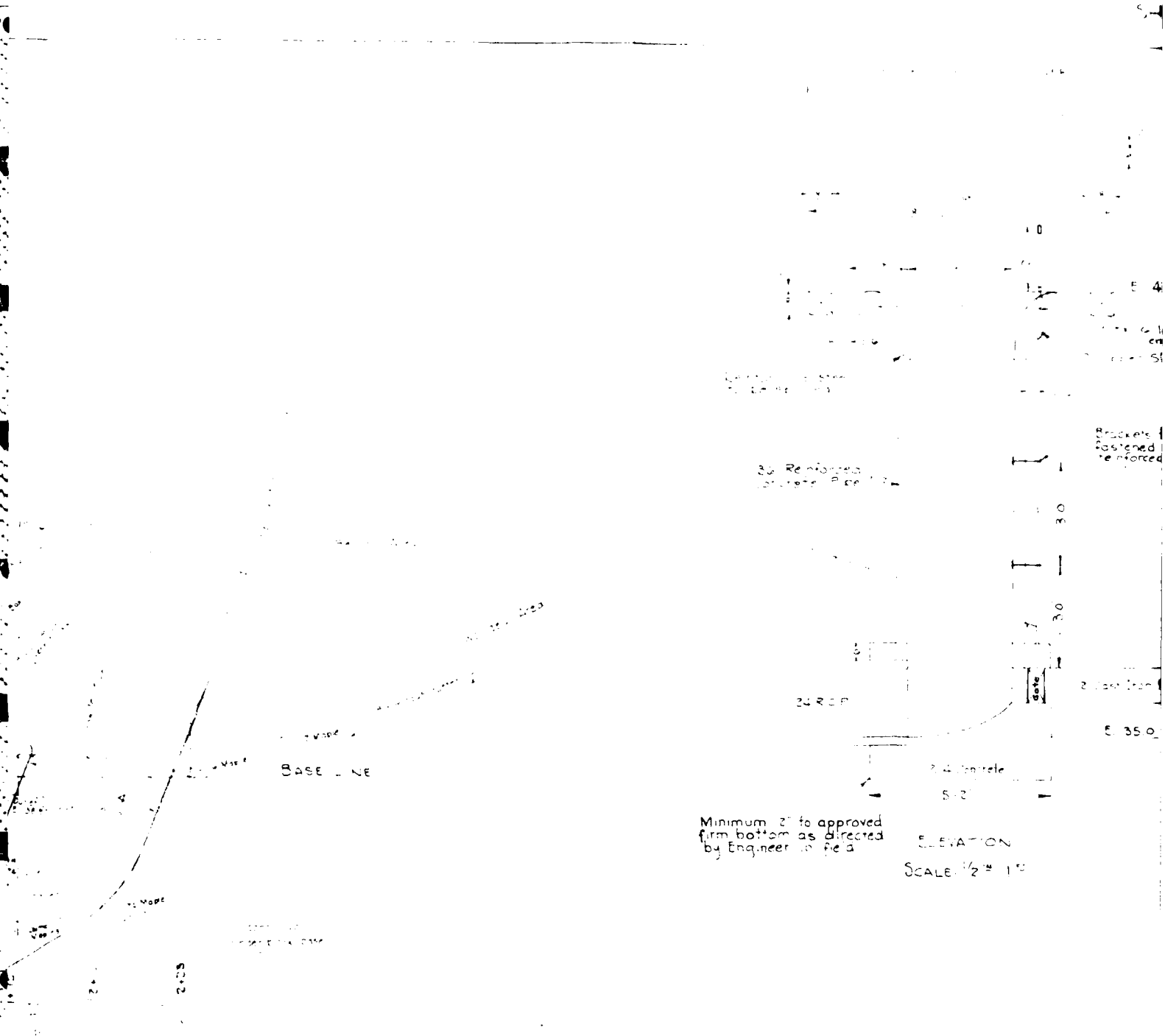




SIDE ELEVATION
SCALE 1/2



CONCRETE CUT



PLAN OF PROPOSED REPAIRS TO DAM AT ECHO LAKE

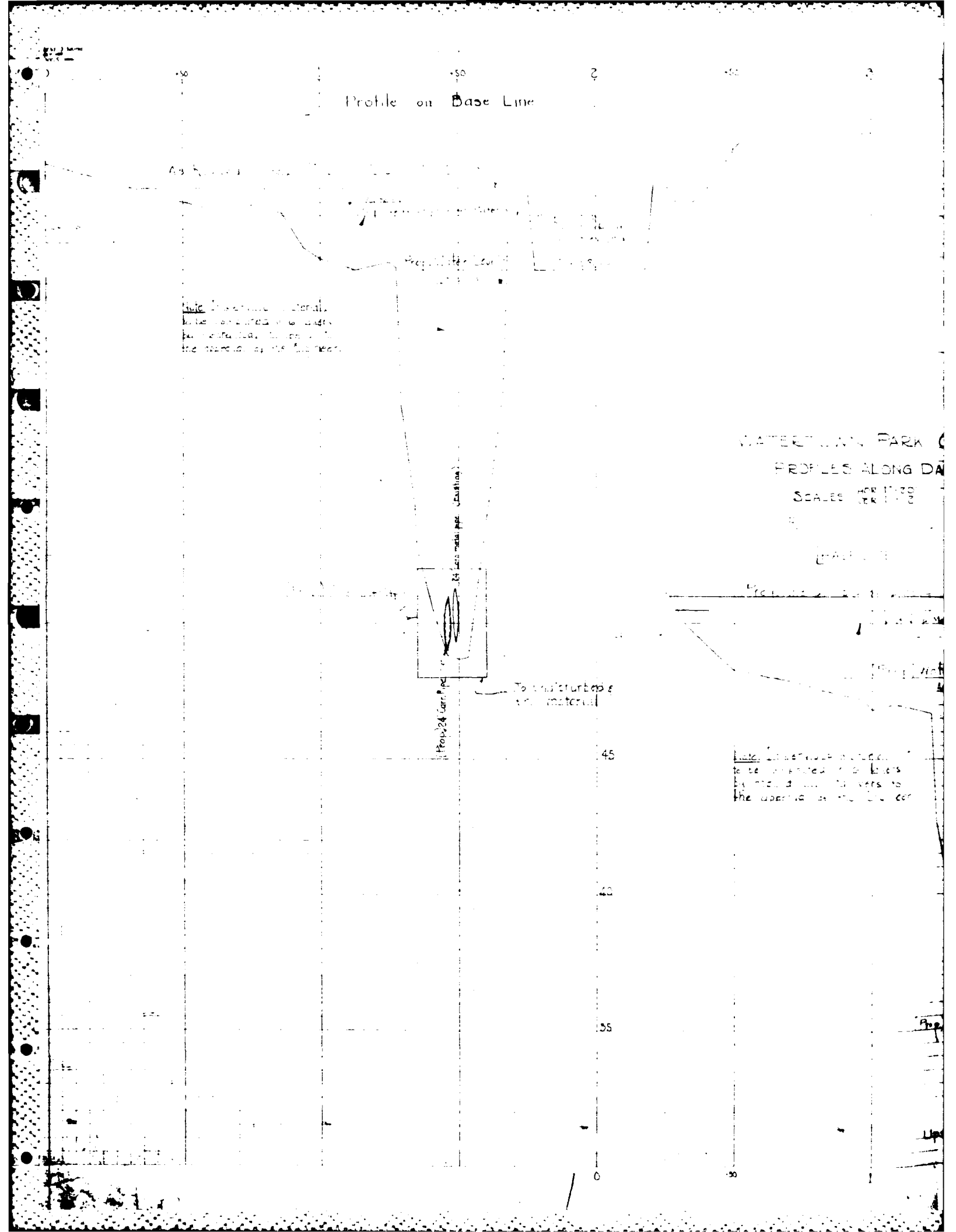
WATERTOWN, CONN

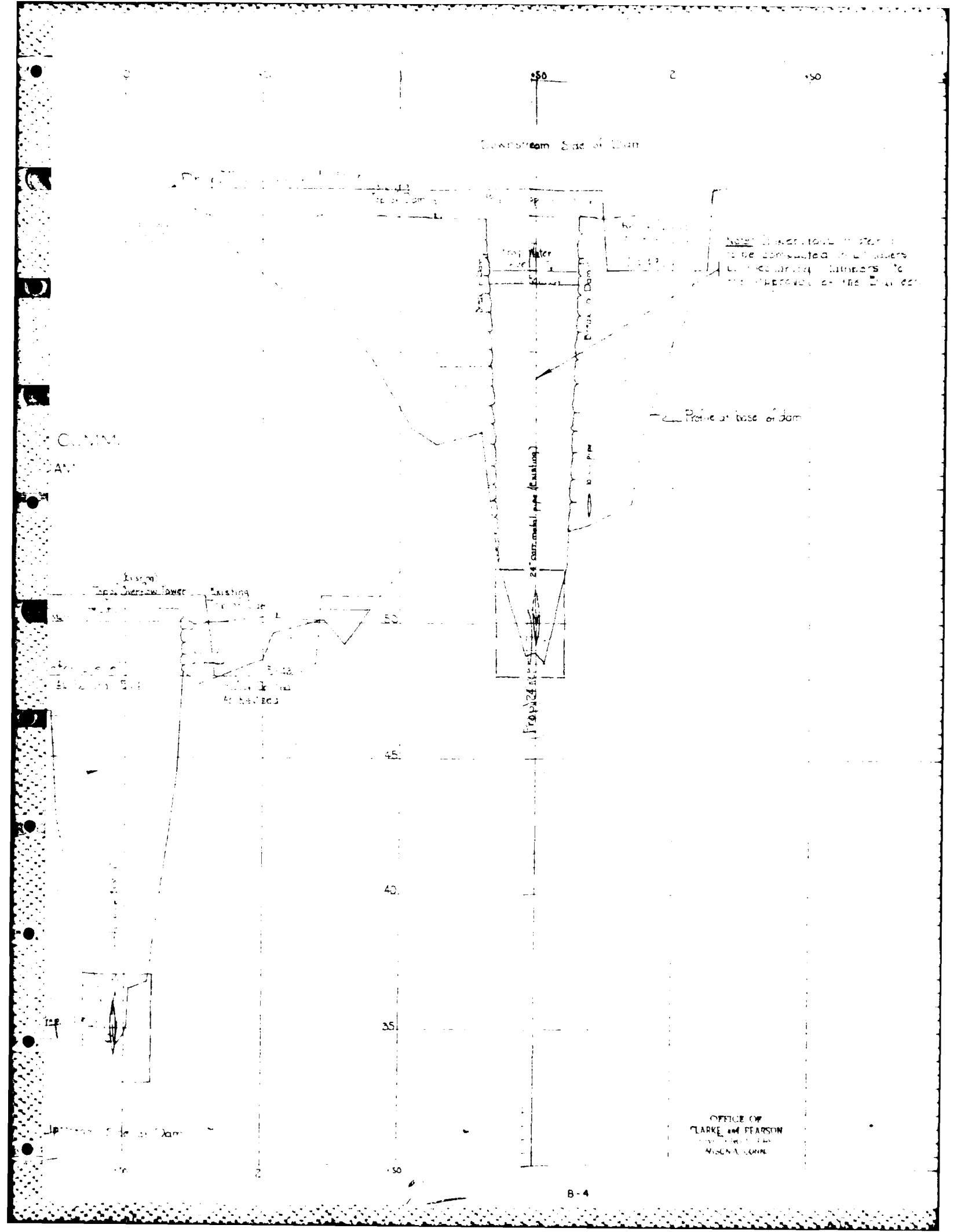
SCALE 1 IN. = 20 FT FEB 1959

Revised May 3

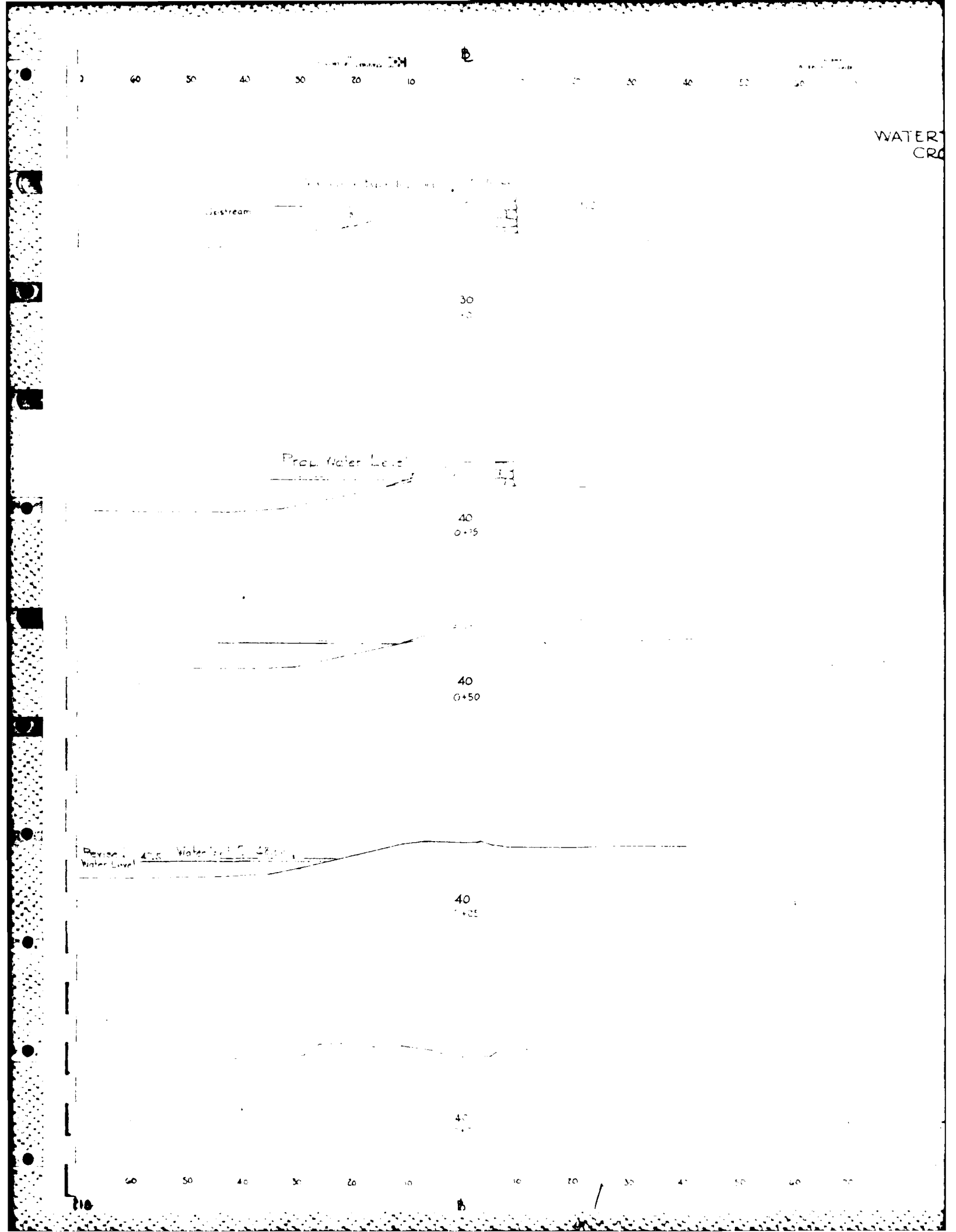
[HALF SIZE]

Profile on Base Line



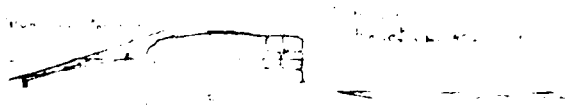


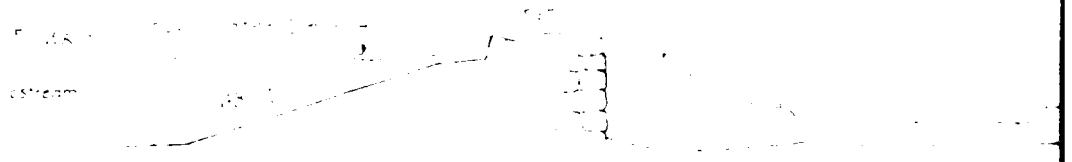
OFFICE OF
CLARKE and PEARSON

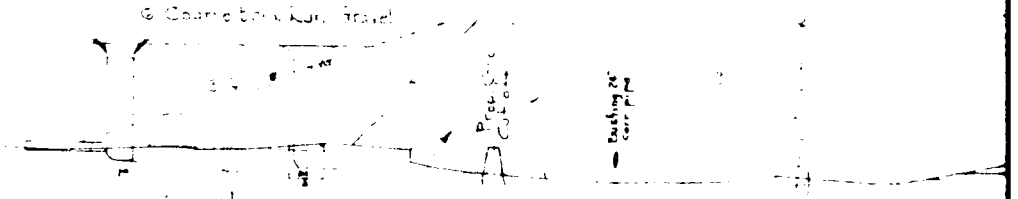

WATER
CR
Upstream
30
Prop. Water Level
40
0+75
40
0+50
Revise
Water Level
40
40

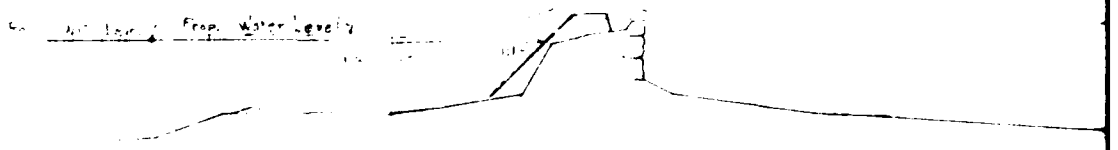
OWN PARK COMM.
SS SECTIONS

[HALF SIZE]









FORM D-4

STATE OF CONNECTICUT
WATER RESOURCES COMMISSION
Room 317, State Office Building
Hartford, Connecticut

RECEIVED
APR 15 1959
State Water Resources Commission

APPLICATION FOR CONSTRUCTION PERMIT FOR DAM

Owner Town of Watertown - Park Commission Date 4/14/59

P. O. Address Watertown
Conn. Tel. No. CR 42531
Mr. A. L. Alves, Chairman

Location of Structure:

Town Watertown Shown on USGS Quadrangle Waterbury

Name of Stream at 2.6 inches ~~xxxx~~ north of Lat. 41°35'
and 1.4 inches ~~xxxx~~ west of Long. 73°05'

Directions for reaching site from nearest village or route intersection:
(see sketch on reverse side)

0.8 mile Easterly from Rte. 63 on French Street and Northerly 0.2 mile on Ice House Road

This is an application for: (New Construction) (Alteration) (Repair) (Removal)
(check one or more of above)

This pond is to be used for: Recreational use

Dimensions of Pond: width 1/10 mile length 1/4 mile area 0.025 sq. mile

Maximum depth of water immediately above dam: 11'

Total length of dam: 200'

Length of spillway: 40'

Height of abutments above spillway: 1.5

Type of spillway construction: Bituminous concrete

Type of dike construction: Earth fill

Spillway section will be set on: (Bedrock) (Gravel) (Clay) (Till)
(check one of above)

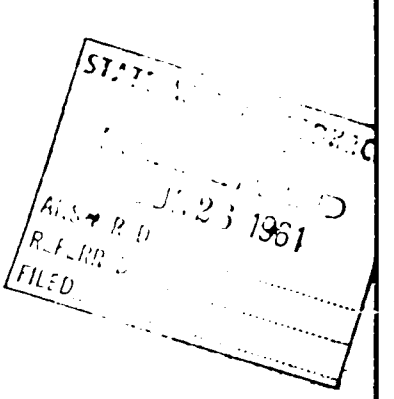
Remarks: Project consists of repairing dam at Echo Lake

Signed: A. L. Alves - Chairman
(owner)

Name of Engineer, if any Clarke and Pearson

~~Note: Show details of construction on reverse side~~.

PHILIP W. GENOVESE & ASSOCIATES
CONSULTING ENGINEERS
294-296 ELM STREET
NEW HAVEN 7, CONNECTICUT
~~XXXXXXXXX~~
SP7-5341



June 22, 1961

Mr. Emitt A. Dell
Water Resources Commission
650 Main Street
Hartford, Connecticut

Re: Echo Lake Dam
Watertown, Connecticut

Dear Mr. Dell:

Enclosed, is copy of the report of Committee appointed by the Superior Court for Litchfield County regarding the Echo Lake Dam failure. The Contractor was found to have not constructed the dam in accordance with the plans and was found liable for damages.

In the meantime, Vincent Clarke was hired, submitted plans for reconstructing the dam, the plans were approved, the dam was built, and finally inspected. There was a wet spot at the foot of the embankment which the design engineers and I wished to keep under observation. As a result a final certificate was never issued. I no longer consider this wet spot a problem or cause for holding up final certificate of approval.

Very truly yours,

PHILIP W. GENOVESE & ASSOCIATES

Philip W. Genovese

PWG/rje
encl.

NO. 15720

TOWN OF WATERTOWN	SUPERIOR COURT
VS.	LITCHFIELD COUNTY
[redacted] IRWIN BROTHERS, INCORPORATED	APRIL 1, 1960

REPORT OF COMMITTEE

The above entitled matter having been referred to the undersigned appointed as a committee by the Superior Court for Litchfield County to hear the evidence and report to the court, we held hearings upon the same at the County Court House at Litchfield on January 29 and February 1, 1960, and at the Superior Court House at Danbury on February 8 and 9, 1960, by agreement of counsel, and report as follows:

1. Prior to April 10, 1958 a pond and dam in the Town of Watertown had been established as a recreation area known as Echo Lake.

2. Prior to said date the Town had placed said area under the jurisdiction of the Park Commission.

3. Said Park Commission had had removed a portion of the dam of said pond to permit the removal of silt from the bottom of a portion thereof to allow for its replacement with sand to make a beach.

4. Before April 10, 1958 the Park Commission had sought bids for the reconstruction of said breached dam in accordance with certain drawings and specifications known as "Drawing B - Engineering drawings showing plan and elevation views of dam at Echo Lake marked sheet 2 of 2" and marked Exhibit 1 - A, B and C.

for the work at Echo Lake Dam and shortly entered upon the premises and replaced the portion of the dam demolished and were paid for the work on June 10, 1938.

6. The water impounded by the dam gradually filled but at all times was below the spillway.

7. On October 1, 1938 the dam burst and collapsed and it is for the damage alleged to have resulted that this suit was instituted.

8. The solution of the cause of the bursting of the new work depends considerably on inference.

9. There had been rain previous to the break.

10. The job had been completed prior to June 10, 1938.

11. On and before October 1, 1938, the night of the break, in a period from four days to the day before October 1, water had been observed flowing through the dam especially at points on either side of the corrugated iron pipe.

12. There were other locations of the escape of water through holes in the dam.

13. The aforesaid leaks were probably symptomatic or indicative of a more deep seated and fundamental weakness.

14. No engineer was employed by the Town which had regarded the project as a special one.

15. The Town became aware that impoundment of waters of the nature of Echo Lake came within the province, authority and jurisdiction of the Water Resources Commission of the State of Connecticut.

16. The plans submitted to that body were drawn by one Reynolds of Watertown, not a certified engineer but a surveyor, which the defendant knew or should have known.

17. These plans were approved by the State Water Resources Commission.

18. One Philip W. Genovese [illegible] engineer representing the State to whom the project was committed.

19. He was an engineer consultant paid by the State. He was not engineer of the Town.

20. One Alexander Alves was chairman of the Park Commission. He happened to be a mechanical engineer. He was not the engineer for the Town.

21. Prior to May 10, 1958, in compliance with the contract and before stones were laid in the wall, Alves sought and obtained the presence of Genovese on the job for the early morning of May 10th.

22. There was a discussion out of which arose the mooted question of the use and authorization of the use of a 3 foot blanket of clay back of the wall.

23. The defendant's foreman claimed he was authorized on said May 10th to use it and it is a fact that Allan Innes directed him to do so.

24. The engineer Genovese whose main concern that morning had to do with the foundation for the wall specifically a variation in the elevation from that called for in the plans, denies recollection so that those parties misunderstood one another.

25. The defendant had wanted to use mortar in the masonry wall and change it from a wall laid up with loose stones to one laid of mortar.

26. If clay was discussed at all, there was no opinion offered that a 3 foot blanket should be laid in the structure as was done. That was the direction of Allan Innes.

27. There is no dispute that sufficient fill to complete the work was not available on the site. Neither the specifications of contract nor the plans provided the nature of material for

for excess fill. Its provision was an added expense. The plaintiff placed great reliance on the defendant's experience and competence in construction work of the nature required, as evidenced by defendant's modification of the dimensions of the wall.

28. In the absence of contract authority, at that period in the construction of the project, in the absence of a town engineer, the decision of such an important engineering question should have either been reduced to writing or the designation of a town engineer by the town be insisted upon by the defendant for decisive opinion, and failure to do so was such negligence as permitted faulty support to the wall by the insertion of the clay blanket layer which eventuated in the breach which was the proximate cause of the consequent damage.

29. The original plan and design were adequate to avoid a collapse if the clay blanket had not been installed.

30. The dam now constructed is a more extensive operation than the dam replaced so that allowing $3500 for the replacement of French Street and $1176.50 for Steel Brook work plus our computation of a fair and reasonable sum for damages for the dam brings us to a total figure of $10,776.50 which we recommend to the Court as a fair and reasonable judgment for the plaintiff to receive and for the defendant to pay.

Committee of the Superior Court

EDWARD J. QUINLAN

HENRY W. BUCK

CHARLES A. CAHN

FORM D-7

STATE OF CONNECTICUT
WATER RESOURCES COMMISSION
Room 317, State Office Building
Hartford, Connecticut

CERTIFICATE OF APPROVAL

Date July 10, 1961

To: ~~Town of Watertown~~

~~Park Commission~~

~~Watertown, Connecticut~~

NAME OF STRUCTURE: Echo Lake Dam

This is to certify that the following construction work:

Repairs to the subject dam in accordance with plans and specifications prepared by Clarke and Pearson, Civil Engineers.

on your property on an unnamed tributary of Steel Brook

in the Town (s) of Watertown

~~for which construction permit was issued~~ _____, has been completed to the satisfaction of this Commission and that such structure is approved as of date of this Certificate.

WATER RESOURCES COMMISSION

BY: William S. Wise
William S. Wise, Director

Note: The owner is required by law to record this Certificate in the land records of the town or towns in which the dam, dike or similar structure is located.

COPY

COPY

STATE OF CONNECTICUT

DEPARTMENT OF ENVIRONMENTAL PROTECTION

STATE OFFICE BUILDING HARTFORD, CONNECTICUT 06115

29 July 1975

Mr. Paul F. Smith
Town Manager
Town Hall
37 DeForest Street
Watertown, CT 06795

Re: Echo Lake Dam
Watertown

Dear Mr. Smith:

According to the records of this department, the Town of Watertown is the owner of a dam known as Echo Lake Dam on Echo Brook in the Town of Watertown.

Under Section 25-11 of the 1975 Revision of the General Statutes of the State of Connecticut, a copy of which is enclosed, this department has jurisdiction over all dams..."which by breaking away or otherwise might endanger life or property". This dam could cause damage in the event of failure and is therefore under the jurisdiction of this department.

This dam was recently inspected in accordance with Section 25-111 of the General Statutes and was found to be in an unsafe condition. This section states in part: "If after any inspection described herein, the Commissioner finds any structure to be in an unsafe condition, he shall order the person, firm or corporation owning or having control thereof, to place it in a safe condition or to remove it and shall fix the time within which such order shall be carried out".

The most serious deficiency noted at this structure was severe undermining and cutting of the asphalt covered emergency spillway section. Further deterioration of the emergency spillway could lead to failure of the structure.

The repairs or alterations to be made should include, but are not necessarily limited to the following items:

1. The undermining of the emergency spillway should be repaired. Stable fill should be placed in this section of the dam to prevent further cutting.

2. All brush and debris should be removed from the embankment slopes of the dam.

3. Any debris caught in the principal spillway intake should be removed.

Please notify this office within two weeks of your intentions in regard to this matter.

Very truly yours,

Robert E. Sonnichsen

Robert E. Sonnichsen
Engineer Intern
Water Resources Unit

RES:ljg

Enclosure

TOWN OF WATERTOWN

CONNECTICUT

06795

Town Hall Annex
424 Main Street

Telephone
(203) 274-5411

August 7, 1975

Mr. Robert Sonnichsen
Engineer Intern, Water Resources Unit
Department of Environmental Protection
State Office Building
Hartford, Connecticut

Re: Echo Lake Dam
Watertown

Dear Mr. Sonnichsen:

Regarding your letter of July 29, 1975 as to the unsafe condition of the above dam; please be advised repairs to this are under way and should be complete within the week. These repairs are basically to the damaged spillway section. In addition, brush has already been cut on the dam embankment and the intake cleaned.

Should you wish to check this out please get in touch with me. I would also like to advise that in the future when you or personnel from your department are inspecting these facilities, kindly contact me so either I or someone from the engineering department can accompany you. Thank you.

Very truly yours,

William B. Owen

William B. Owen, P.E.
TOWN ENGINEER

WBO:hel

cc: Paul Smith, Town Manager

Break In Watertown Dam Looses Flash Flood Tide

10 Homes Evacuated Temporarily; 2 Roads Washed Out, Torn Up

By JOSEPH O'DONOVAN

Watertown, Oct. 1 — Echo Lake Dam, fresh after a spring-time cleaning and face - lift, burst last night, spilling its 12 acres of water into the small tributary of Steel Brook which parallels Riverside St. here.

At least 10 homes in the low-lands from the lake to Pin Shop were temporarily flooded in the mad but momentary rush of water down the mile and one-half watercourse.

Several families were forced to evacuate their homes during the height of the flash flood, but rapidly receding waters permitted almost immediate re - entry of the houses.

Police report no one injured and all residents of the area apparently accounted for after the hour - long memory of the 1955 floods had run its course.

Washed out when the dam at the town - owned recreation facility let go were two roadways which cross the normally - complacent brook. A gaping 14 - foot deep gulley, at least 25 feet across, was cut by the water at the French St. cross - over. Further downstream, the pavement of Tower Rd. was torn up and tossed about by the wall of water, leaving the street impassable.

At the height of the flood, before the French St. culvert gave way, water at that intersection was from two to three feet deep on the streets. This would be put the minimum depth of the backed - up flood waters at 14 feet above the normal level of the brook, area residents agreed.

Bought by Town

The Echo Lake property was bought by the town for a swimming area three years ago for $35,000. The dam which burst is a cement - capped earthern structure about 50 feet across and, at its highest point, 5 feet high. It backs up about 12 acres of water which reaches a depth of about 20 feet near the dam.

The town spent some $9,000 this spring to drain the pond clean dirt and debris from the lower portion and repair the breach opened in the dam to drain the lake.

According to Alexander Alves, of the Park Board, the project had been approved by engineers representing the State Water Resources Commission. The lake was cleaned and the dam breach was closed by the Inner Bros. of Thomaston. The Park Commission chairman said the contractor had furnished a performance bond for the project, but he didn't know what kind of a guarantee was on the dam repair job.

First Report

First report of the break at the dam apparently came to police from Elaine Daddona, 11-year - old daughter of Mr. and Mrs. Al Daddona, whose home is at the corner of Riverside and French Sts.

Police Lt. Carlo Palomba reported that he got a call from the Daddona girl at about 6:55 p. m.

"The dam above the house has broke. Our house is going to be washed away. That's what she told me," Palomba

(Cont'd on Page 4—DAM)

Dam---

(Continued from Page One)

said. "But I knew what she meant."

Meanwhile, closer to the dam itself, Mrs. Joseph Mango, of Ice Hose Rd., heard what she said "sounded like thunder," from the vicinity of the lake. This was about 6:45 p. m.

"I grabbed my two boys, (ages nine and eleven) get into my car and beat it," she continued, although her home is on high ground, not in the path of the water.

Mrs. Mango got her husband and Al Daddona and the trio sped down to the Daddona home.

"The water was already two feet deep in my front yard," Daddona said. "I charged through water up to my knees up to the house to get the kids and my father - in - law out."

Daddona apparently got to his home when the flood was near its crest, as the water started immediately to recede. While some seepage into ground-floor living areas was reported, most damage to homes was confined to flooded cellars, washed-out yards and undermined foundations. In the darkness, extent of such outdoors damages could only be guessed.

At the Louis Cotta home, on Tower Rd., water ran several feet deep in the cellar at one point. Cotta reports that he was reading the paper at about 7 p. m. when his wife, who was working in the cellar, hollered, "Look at all the water."

He said he ran outside to see the brook spilling over its banks some 40 - feet behind his house. He started to move some summer furniture.

"But it was no use," he said. "In five minutes the water moved 40 feet and was running two feet deep past my garage."

All efforts to determine last night what might have caused the break were of no avail.

Park Commission Chairman Alves said efforts failed to reach the insurance agent with the policy on the dam and recreation area and "there is no way to tell the loss."

Alves said the dam was checked Sunday and again today by Joseph Gallagher, a commission employe, and "there wasn't a sign of a leak" either time.

Dam Bursts At Echo Lake, Flooding Watertown Homes

Meriden Record

WATERTOWN, Conn., Oct. 1 (AP) — A 25-foot-high earthen dam on Echo Lake burst tonight, unleashing a flash flood that caused the temporary evacuation of several homes.

The rush of water from the 12-acre lake reached a maximum height of 14 feet, but there were no injuries reported. Police said all residents were accounted for.

The waters pounded into a small tributary of Steel Brook, but the tributary was unable to contain the flood.

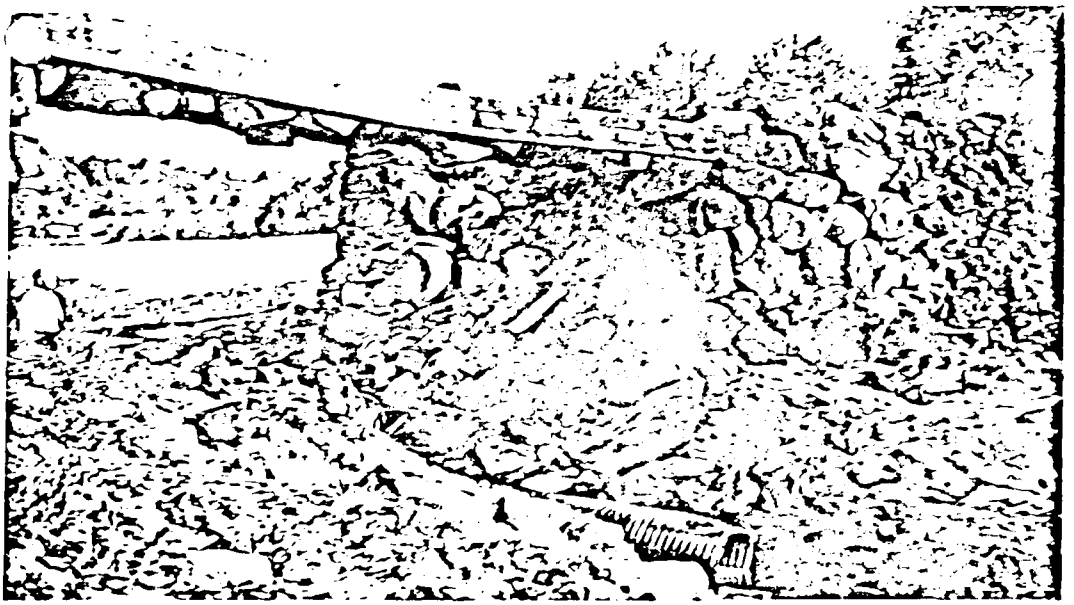
At the height of the flood several families were forced to evacuate their homes, but the waters receded rapidly and reentry was almost immediate.

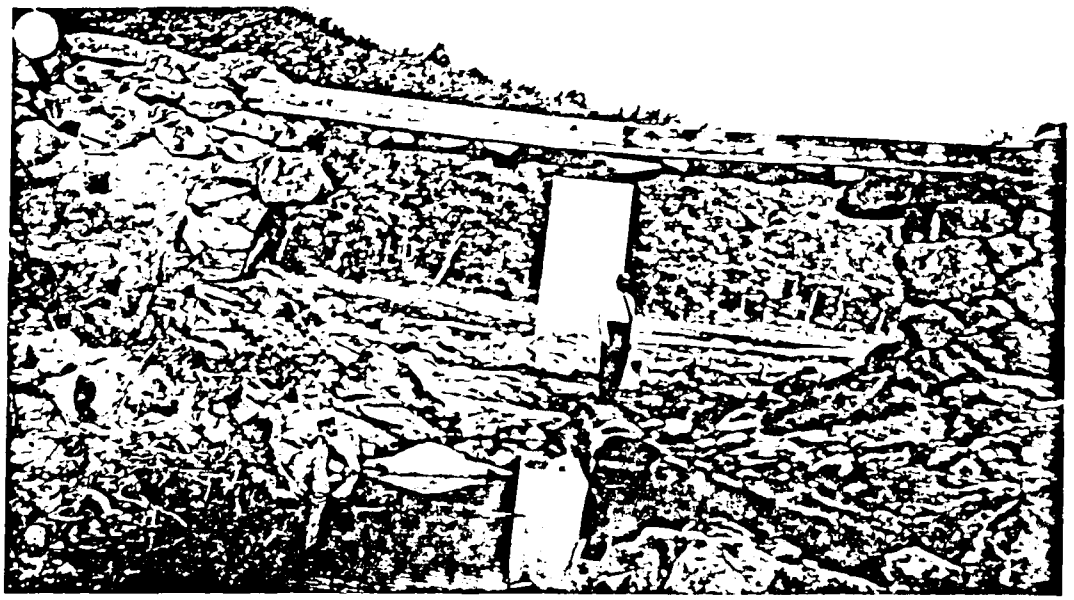
The fast-moving waters whipped by most of the houses in their path. At least 12 homes were temporarily flooded but most of these had cellar damage. First floor seepage was reported in a few structures.

No estimate of damage to public or private property was immediately available. It was not learned what caused the break in the town-owned dam.

Echo Lake is used for recreation purposes, swimming intluded.

10-2-58

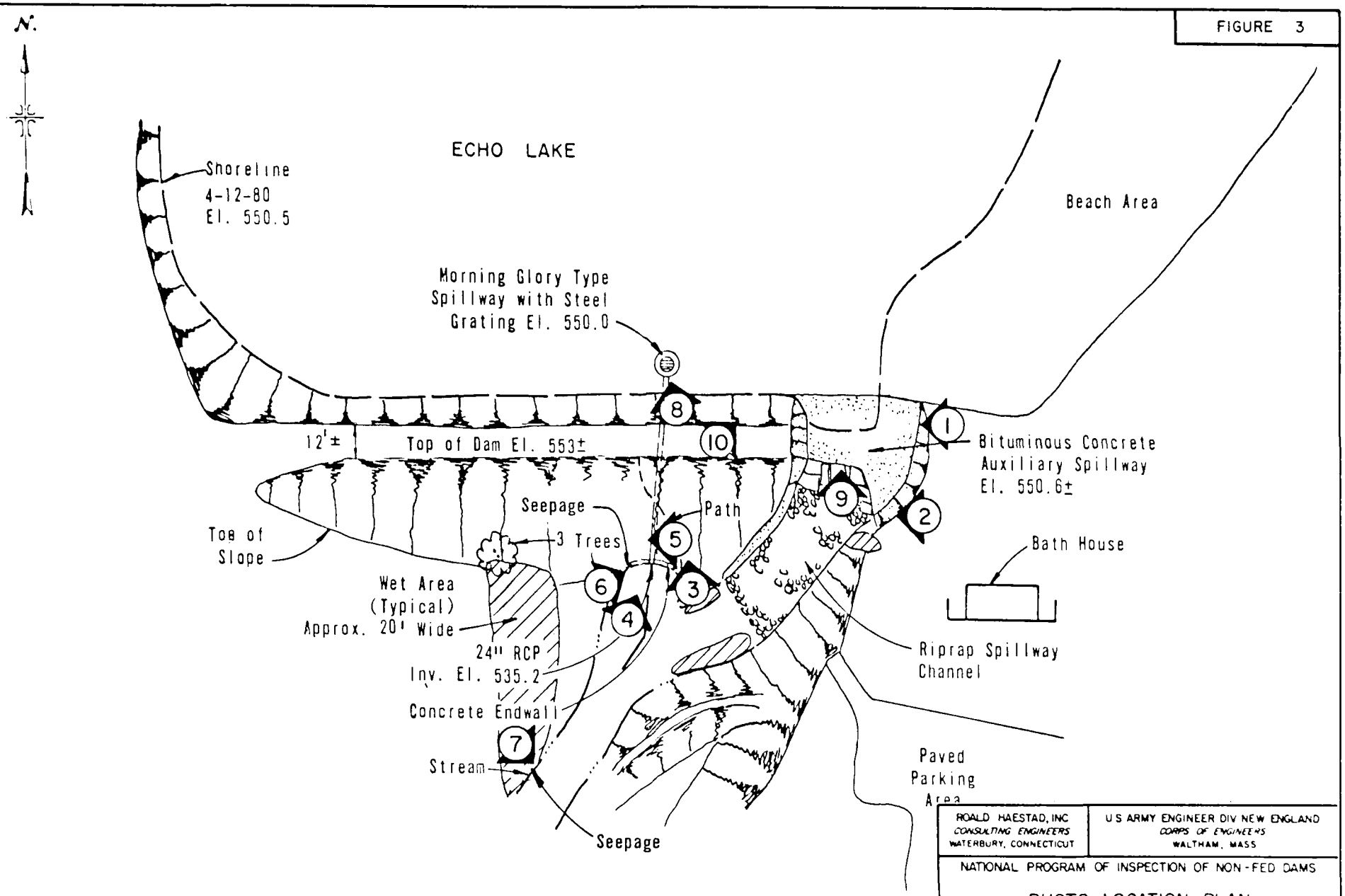




APPENDIX C

PHOTOGRAPHS

FIGURE 3



Denotes photo number and direction in which photo was taken.

ROALD HAESTAD, INC CONSULTING ENGINEERS WATERBURY, CONNECTICUT	US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

PHOTO LOCATION PLAN

ECHO LAKE DAM

WATERTOWN, CONNECTICUT

DRAWN	CHECKED	APPROVED	SCALES 1"=40'
JRS	RGL	RH	DATE JUNE 1980 PAGE C-1

PHOTO NO. 1

DAM FROM LEFT ABUTMENT

PHOTO NO. 2

AUXILIARY SPILLWAY DISCHARGE CHANNEL AND DOWNSTREAM SLOPE OF DAM. NOTE WET AREA ADJACENT TO TOE AS INDICATED BY DARK GREEN VEGETATION.

U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	ECHO LAKE DAM ECHO LAKE BROOK WATERTOWN, CT. CT00124 2 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 3

DOWNSTREAM FACE OF DAM NEAR CONCRETE ENDWALL. NOTE EROSION PATH AND SLUMPING AROUND ENDS OF WALL.

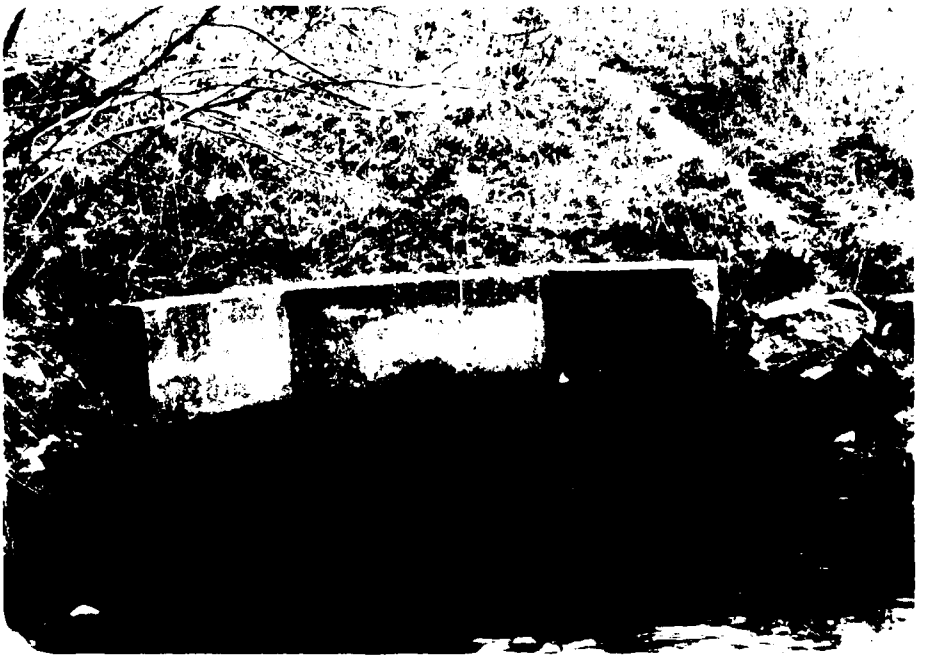


PHOTO NO. 4

CONCRETE ENDWALL AT OUTLET OF 24-INCH RCP. NOTE SLUMPING AT ENDS OF WALL.

U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	ECHO LAKE DAM ECHO LAKE BROOK WATERTOWN, CT. CT00124 2 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 5

HOLE ON SLOPE JUST UPSTREAM
OF CONCRETE ENDWALL

PHOTO NO. 6

SEEPAGE ADJACENT TO RIGHT
END OF CONCRETE ENDWALL

U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	ECHO LAKE DAM ECHO LAKE BROOK WATERTOWN, CT. CT00124 2 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 7

POSSIBLE SEEPAGE
APPROX. 60 FEET
DOWNSTREAM OF TOE

PHOTO NO. 8*

INLET TO MORNING
GLORY TYPE SPILLWAY.
NOTE DEBRIS ON
GRATING.

*12 APRIL '80

U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	ECHO LAKE DAM
		ECHO LAKE BROOK
		WATERTOWN, CT.
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		CT00124
		2 MAY '80

PHOTO NO. 9

BITUMINOUS CONCRETE OF
AUXILIARY SPILLWAY

PHOTO NO. 10

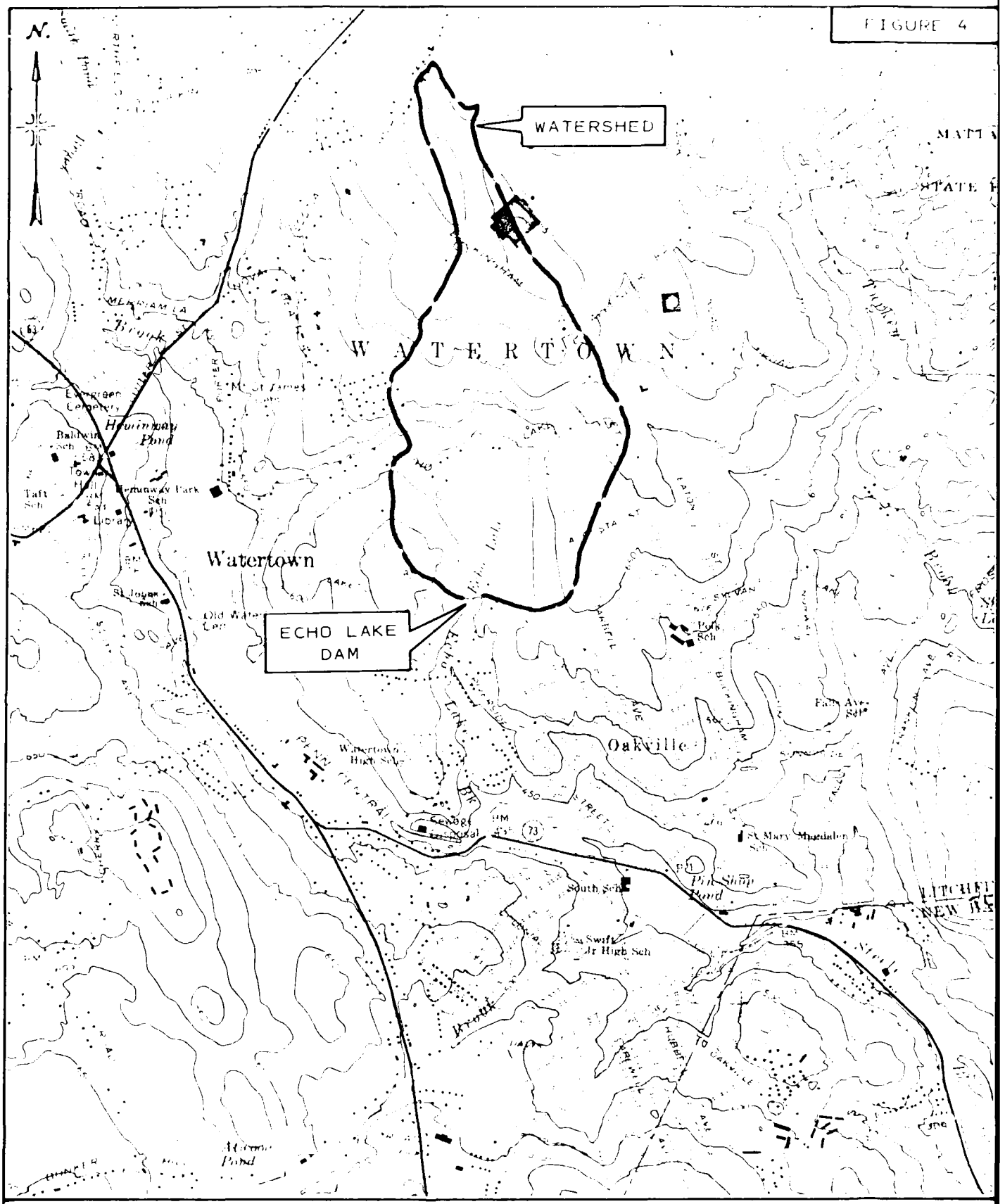
BEACH UPSTREAM OF AUXILIARY SPILLWAY
APPEARS TO OBSTRUCT FLOW

U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	ECHO LAKE DAM ECHO LAKE BROOK WATERTOWN, CT. CT00124 2 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

FIGURE 4



WATERSHED MAP

ECHO LAKE DAM
WATERTOWN, CONNECTICUT

SCALE: 1" = 2000'

ROALD HAESTAD, INC.

WATERBURY QUADRANGLE 1972

BY SA DATE 5/7/80 **ROALD HAESTAD, INC.** SHEET NO 1 OF 13

CONSULTING ENGINEERS

CKD BY ____ DATE 5/14/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-20

SUBJECT ECHO LAKE DAM - Discharge Capacity

Auxiliary Spillway Data:

1) Length = 32' (37' used for computations)
2) Elevation = 550.6
3) Spillway Section is an asphalt paved section
4) Coefficient of discharge = 2.9

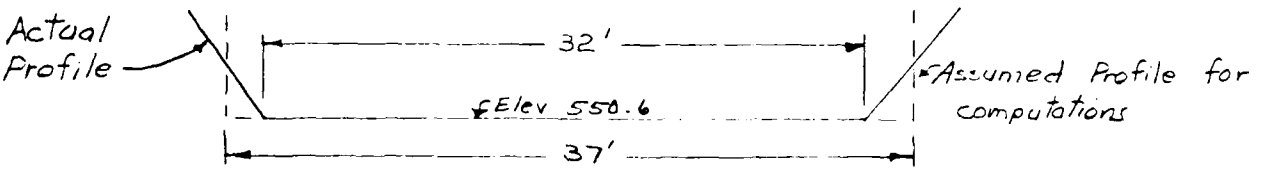
Dam Data:

1) Length = 180'
2) Elevation = 553.0
3) Coefficient of discharge = 2.7

24" Outlet Pipe: (MORNING GLORY SPILLWAY)

1) Length = 56'
2) Elevation = Invert 535.2, Top of Gmte = 550.0
3) Entrance loss = $0.5\ V_2^2/2g$
4) Friction loss = $f(L/D)(V_2^2/2g)$

Auxiliary Spillway Profile:



Spillway apron consists of broad asphalt section discharging into a riprapped channel.

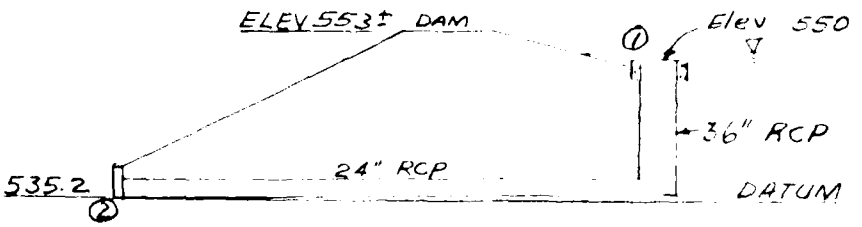
24" Outlet Pipe: (MORNING GLORY SPILLWAY)

Use Bernoulli Eq.

$$z_1 + P_1/\gamma + V_1^2/2g = z_2 + P_2/\gamma + V_2^2/2g + H_L$$

$$z_1 = V_2^2/2g + H_L$$

$$z_1 = (f(L/D) + 0.5 + 1)\ V_2^2/2g$$



SUBJECT ECHO LAKE DAM - Discharge Capacity

Auxiliary Spillway & Dam Discharge Eq. = $Q = CLH^{3/2}$

Morning Glory Spillway = Bernoulli Equation (see page 1 of 13) using a trial & error solution
= $z_1 = (f(4/0) + 0.5 + 1) V_2^2/2g \rightarrow V_2 \rightarrow Q = V_2 A$

Elev. 550.6 :
$z_1 = 15.4'$ V_2 (assumed) = 20 ft/sec $\rightarrow f = 0.035 \rightarrow V_2 = 20$ ft/sec

$\therefore Q = V_2 A = 20 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 63$ cfs

Elev. 551 :
$z_1 = 15.8'$ V_2 (assumed) = 20 ft/sec $\rightarrow f = 0.035 \rightarrow V_2 = 20.3$ ft/sec

$\therefore Q = V_2 A = 20.3 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 64$ cfs

Elev. 552 :
$z_1 = 16.8'$ V_2 (assumed) = 21 ft/sec $\rightarrow f = 0.03495 \rightarrow V_2 = 20.9$ ft/sec

$\therefore Q = V_2 A = 20.9 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 66$ cfs

Elev. 553 :
$z_1 = 17.8'$ V_2 (assumed) = 22 ft/sec $\rightarrow f = 0.0349 \rightarrow V_2 = 21.5$ ft/sec

$\therefore Q = V_2 A = 21.5 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 68$ cfs

Elev. 554 :
$z_1 = 18.8'$ V_2 (assumed) = 22 ft/sec $\rightarrow f = 0.0349 \rightarrow V_2 = 22.1$ ft/sec

$\therefore Q = V_2 A = 22.1 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 69$ cfs

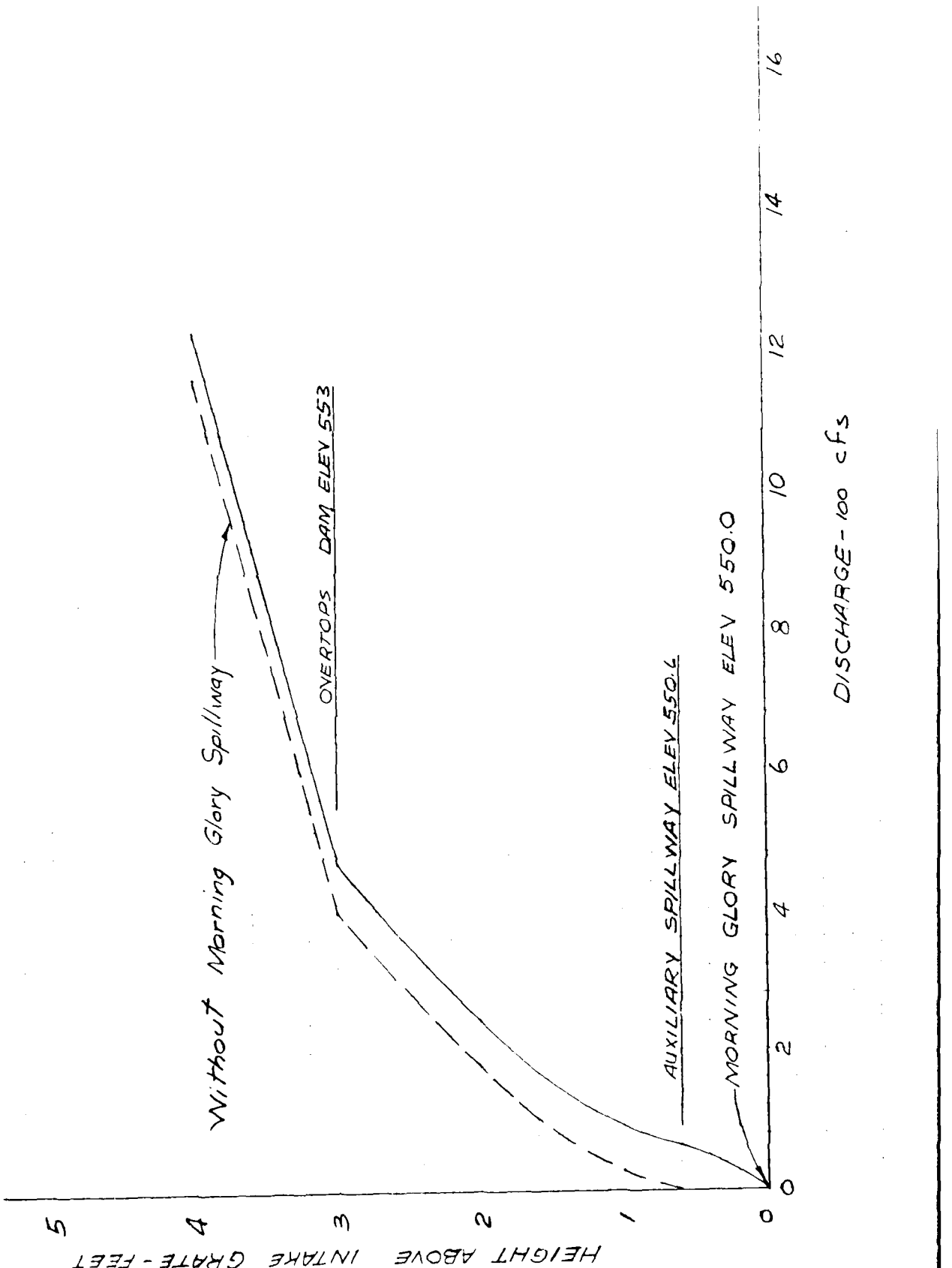
ELEV (ft)	MORNING GLORY SPILLWAY DISC (cfs)	AUXILIARY SPILLWAY DISC. (cfs)	DAM DISCHARGE (cfs)	TOTAL DISCHARGE (cfs)
550	0	0	0	0
550.6	63	0	0	63
551	64	27	0	91
552	66	178	0	244
553	68	399	0	467
554	69	673	486	1,228

BY SAL DATE 5/7/82 **ROALD HAESTAD, INC.** SHEET NO 3 OF 13

CONSULTING ENGINEERS

CKD BY ___ DATE ___ 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-20

SUBJECT ECHO LAKE DAM - Discharge Capacity Curve



BY SAL DATE 6/5/80 **ROALD HAESTAD, INC.** SHEET NO 4 OF 13

CONSULTING ENGINEERS

CKD BY DATE 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-020

SUBJECT ECHO LAKE DAM - Surcharge Storage Capacity

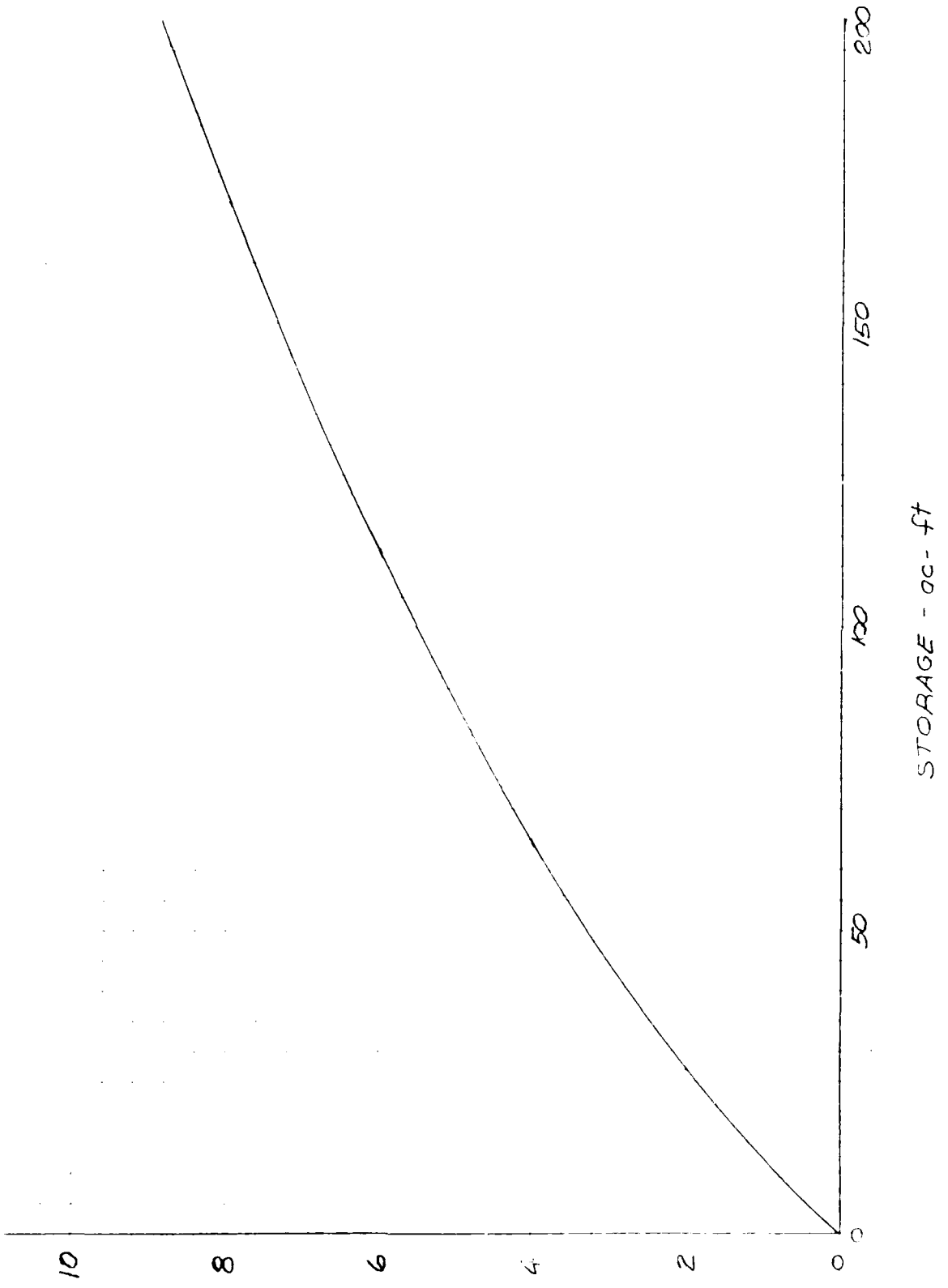
Height Above Intake Grate (ft)	Surface Area (Acres)	Average Surface Area (Acres)	Storage Capacity (Ac-ft)
0	11.0		0
		13.55	
2	16.1		27.1
		18.7	
4	21.3		64.5
		23.85	
6	26.4		112.2
		29.0	
8	31.6		170.2
		34.15	
10	36.7		238.5

BY SAL DATE 5/7/80 **ROALD HAESTAD, INC.** SHEET NO 5 OF 13

CONSULTING ENGINEERS

CKD BY ... DATE ... 37 Brookside Road - Waterbury, Conn 06708 JOB NO 049-20

SUBJECT ECHO LAKE DAM - Surcharge Storage Capacity Curve



Test Flood = 1/2 PMF

Drainage Area = 0.58 sq mi

From Corps of Engineers chart for "Rolling" Terrain

MPF = 2,125 cfs/sq mi (2.0 sq mi Minimum)

PMF = 2,125 cfs/sq mi × 0.58 sq mi = 1,232.5 cfs

1/2 PMF = 1/2 (1,232.5 cfs) = 616 cfs

Q_{P1} = 616 cfs

H_1 = 3.3' above intake grate, from Discharge Curve

$STOR_1$ = 50 ac-ft, from Storage Capacity Curve

= 1.6" runoff from 0.58 sq mi

MPF Runoff in New England equals approx. 19" ∴ for 1/2 MPF Runoff equals approx. 1/2 (19") = 9.5"

$Q_{P2} = Q_{P1}(1 - STOR_1/9.5) = 616 \text{ cfs}(1 - 1.6/9.5) = 512$ cfs

H_2 = 3.2 ft $STOR_2$ = 48 ac-ft

$STOR_{AVE} = (STOR_1 + STOR_2)/2 = (48 + 50)/2 = 49$ ac-ft
= 1.6" of runoff

$Q_{P3} = Q_{P1}(1 - STOR_{AVE}/9.5) = 616 \text{ cfs}(1 - 1.6/9.5) = 512$ use 510 cfs

H_3 = 3.1

Discharge from Morning Glory Spillway is neglected in calculating the % of test flood that can be discharged by dam safely because during a storm debris could reduce or completely stop discharge through the pipe.

Spillway Capacity = $CLH^{3/2}$
(At top of dam) = $2.9(37)(2.4)^{3/2}$ = 395 use 400 cfs

% of 1/2 PMF = $(400/510) \times 100$ = 78%

S = Storage at time of failure = Storage at spillway level + Freeboard storage

$S = (11\,ac \times 8\,ft) + (11\,ac \times 3\,ft)$

$S = 88\,ac\text{-}ft + 33\,ac\text{-}ft = 121\,ac\text{-}ft$

Q_{pl} = Peak Failure Outflow = $\frac{8}{27} W_b \sqrt{g}\, Y_o^{3/2}$

W_b = Breach Width = 40% of dam length across river at mid height = 0.4(115) = 46 ft

Y_o = Total height from river bed to pool level at time of failure = 18'

$Q_{pl} = \frac{8}{27}(46)(\sqrt{32.2})(18)^{3/2} = 5{,}906$ use 5,900 cfs

Note: Because of the small amount of Storage avnilnble within the reaches, the Peak Failure Outflow (Q_{pl}) was assumed constant and a depth calcuted at each section for Q_{pl}.

BY SAH DATE 4/14/80 **ROALD HAESTAD, INC.** SHEET NO 6 OF 3

CONSULTING ENGINEERS

CKD BY [illegible] DATE 5/25/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-20

SUBJECT ECHO LAKE DAM - Flood Routing

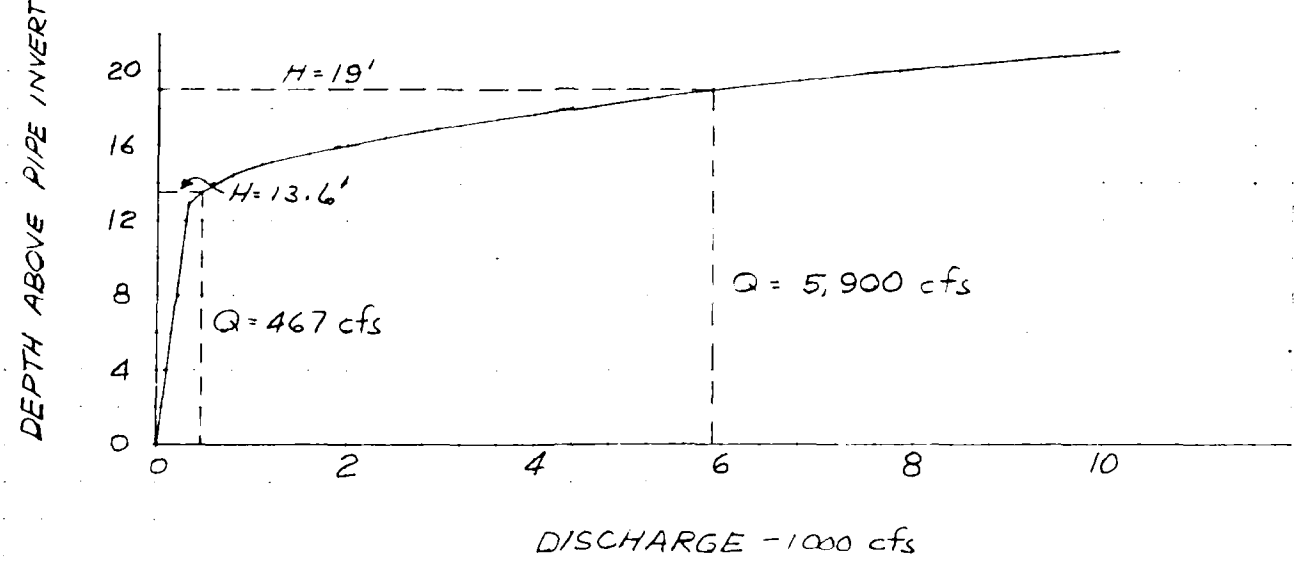
SECTION NO 1 (French St) (SEE FIGURE 5) Scale 1" = 100' Horiz
(Field Surveyed) 1" = 20' Vert

Assume C = 2.5

ELEV 90

Q ← CULVERT
60" CONCRETE PIPE

ELEV.	Q_{PIPE}	$Q_{ROAD} = CLH^{3/2}$	$Q_{TOTAL} = Q_{PIPE} + Q_{ROAD}$
87	0	0	0
91	90	0	90
95	205	0	205
99	280	0	280
100	300	0	300
101	315	275	590
102	330	778	1,108
103	345	2,256	1,911
104	360	2,589	2,949
105	370	3,927	4,297
106	380	5,531	5,911
107	390	7,482	7,872
108	400	9,732	10,132



SECTION NUMBER 2

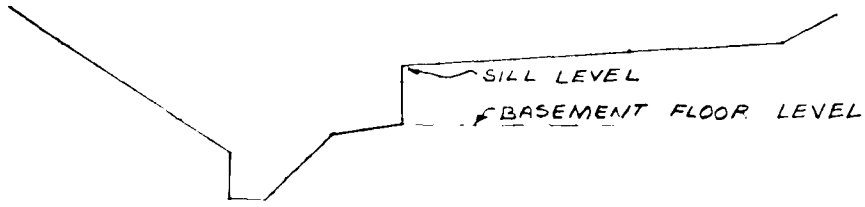
(DST OF FRENCH ST)

H	W	A	R	S	V	Q
1.0	10	8	.74	.0430	4.22	3
2.0	13	17	1.30	.0430	6.13	107
3.0	17	30	1.77	.0430	7.50	225
4.0	20	44	2.19	.0430	8.64	377
5.0	23	60	2.57	.0430	9.63	573
6.0	29	80	2.77	.0430	10.12	809
7.0	37	105	2.85	.0430	10.32	1083
8.0	52	144	2.75	.0430	10.08	1453
9.0	57	191	3.37	.0430	11.55	2205
10.0	61	241	3.96	.0430	12.86	3094
11.0	65	294	4.52	.0430	14.04	4121
12.0	69	350	5.05	.0430	15.12	5285
13.0	73	409	5.57	.0430	16.13	6591
14.0	78	471	6.06	.0430	17.08	8039

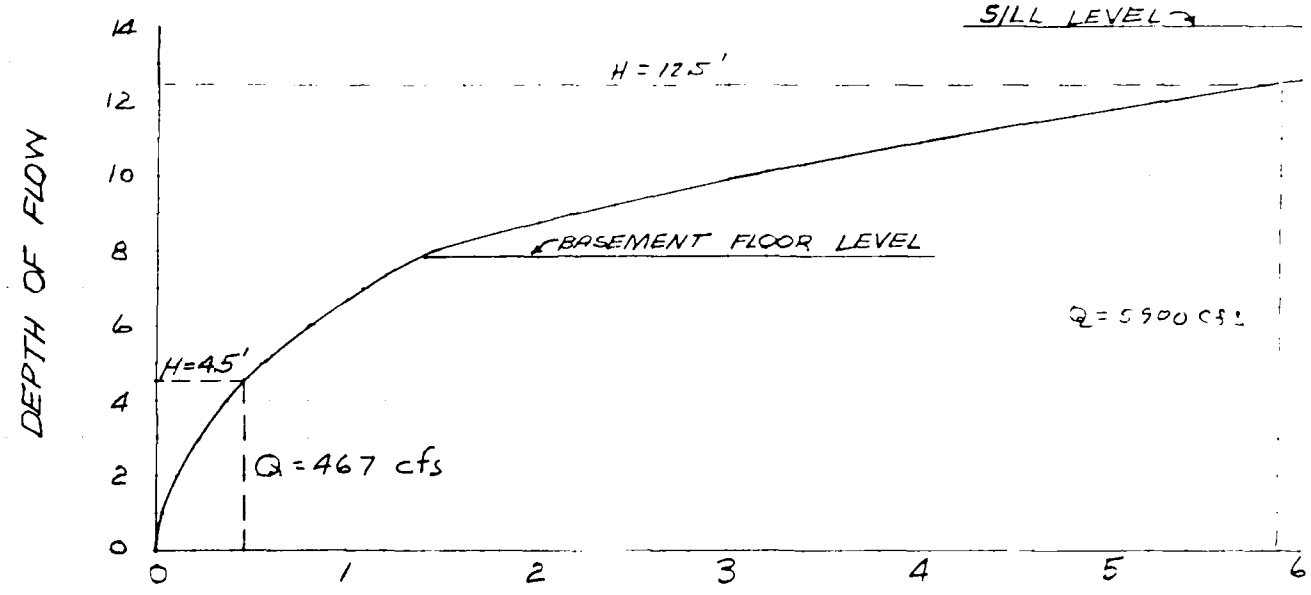
MANNING COEFFICIENT=N=.0600

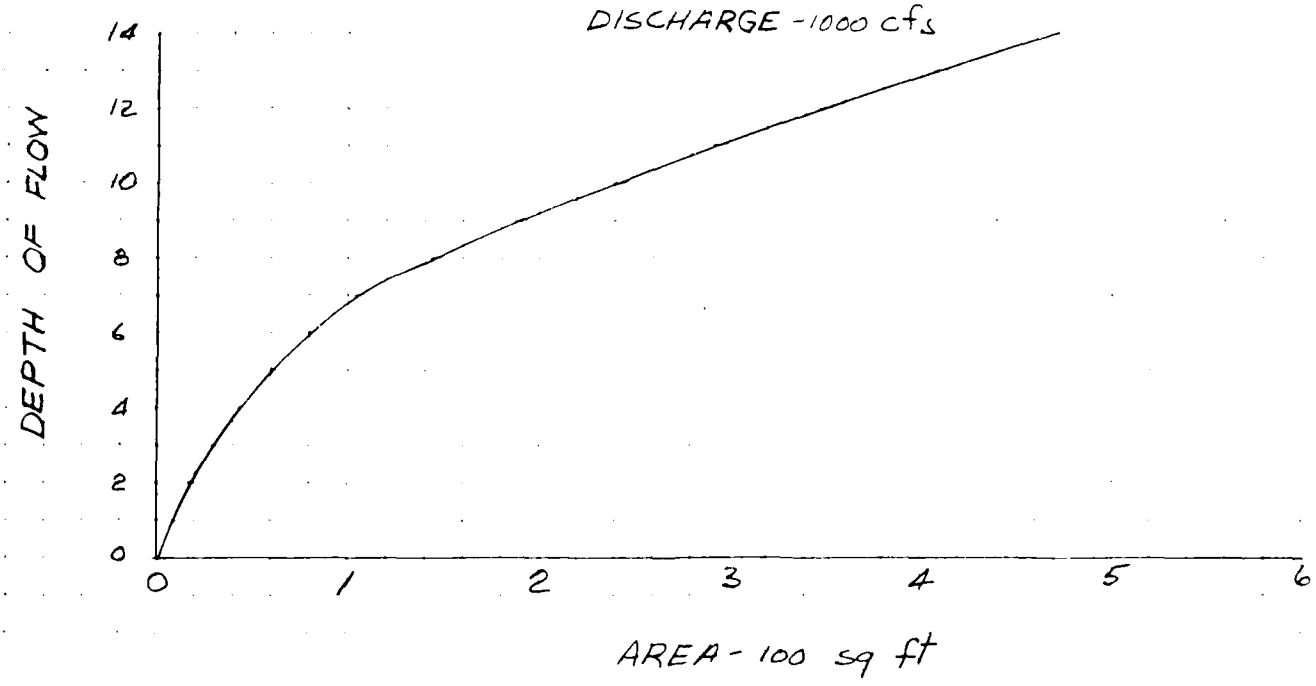
REACH OUTFLOW=QP2= 5900 CFS
DEPTH OF FLOW=H2= 12.5 FT.

SECTION NO 2 (Downstream of French St.) Scale: 1" = 40' Horiz
(SEE FIGURE 5) (Field Surveyed) 1" = 20' Vert



S = 0.043
n = 0.06





BY SAL DATE 4/14/80. **ROALD HAESTAD, INC.** SHEET NO 11 OF 13

CONSULTING ENGINEERS

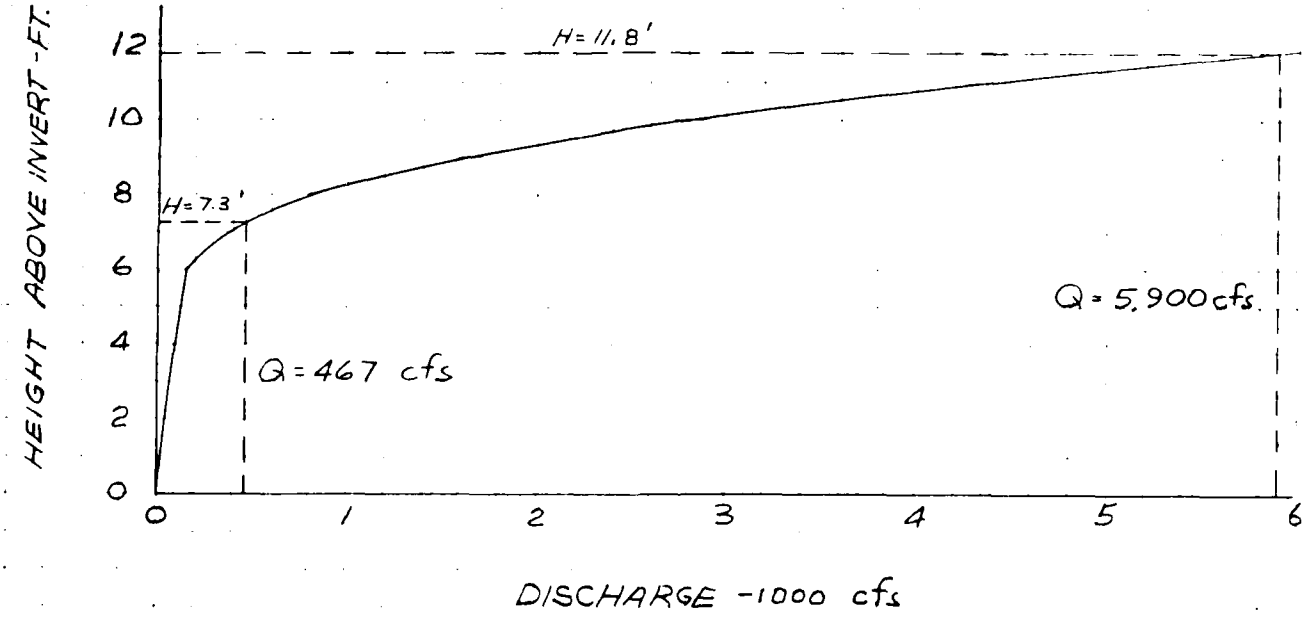
CKD BY DAH DATE 5/22/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-20

SUBJECT ECHO LAKE DAM - Flood Routing

SECTION NO 3 (Tower Road) (SEE FIGURE 5) Scale: 1"=100' Horiz
(Field Surveyed) 1"=20' Vert

Elev.	Q_{PIPE}	$Q_{ROAD} = CLH^{3/2}$	Q_{TOTAL}
93	0	0	0
97	90	0	90
99	155	0	155
100	182	213	395
101	205	601	806
102	230	1,404	1,634
103	250	2,548	2,798
104	265	4,110	4,375
105	280	6,018	6,298

1) Assume Section will discharge as a spillway. Therefore C=2.5.
2) Assume pipe will discharge under inlet control conditions



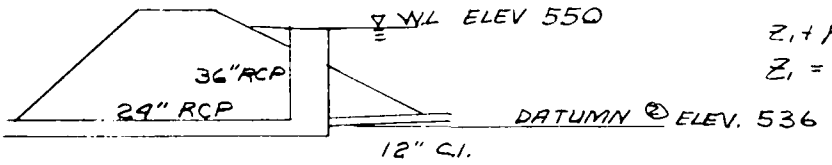
SUBJECT ECHO LAKE DAM - Blowoff Capacity

Note: All the data for the blowoff was taken from existing plans. The data could not be field checked.

Data: 1) The blowoff consists of a 12-inch cast iron pipe
2) Invert Elev. at discharge point is approx. 536
3) Length of pipe is approx 12 ft.

BERNOULLI EQUATION

$$Z_1 + P_1 + V_1^2/2g = Z_2 + P_2 + V_2^2/2g + H_{L1-2}$$
$$Z_1 = V_2^2/2g + H_{L1-2}$$



Head loss: 1) in pipe = $f(L/D) V_2^2/2g$
2) Entrance = $K V_2^2/2g$ ($K = 1$)
3) Gate Valve = $K V_2^2/2g$ ($K = 0.25$)

$$14 = (f(12/1) + 1 + 0.25 + 1) V_2^2/2g$$

Trial & Error Solution:

$V_{2(ASSUMED)} = 8$ ft/sec $\longrightarrow f = 0.038 \longrightarrow V_2 = 18.3$ ft/sec

$V_{2(ASSUMED)} = 18$ ft/sec $\longrightarrow f = 0.0362 \longrightarrow V_2 = 18.3$ ft/sec

$$\therefore Q = V_2 A$$
$$= 18.3 \text{ ft/sec} \times (\pi (1)^2/4)$$
$$= 14 \text{ cfs}$$

Planimeter Readings:

1) Surface Areas: Third = 2.02 sq in 0.12
First = 1.78 sq in 0.12
Start = 1.66 sq in

$$0.12\ in^2 \times \frac{(2000\ ft)^2}{in^2} \times \frac{1\ acre}{43{,}560\ ft^2} = 11\ acres$$

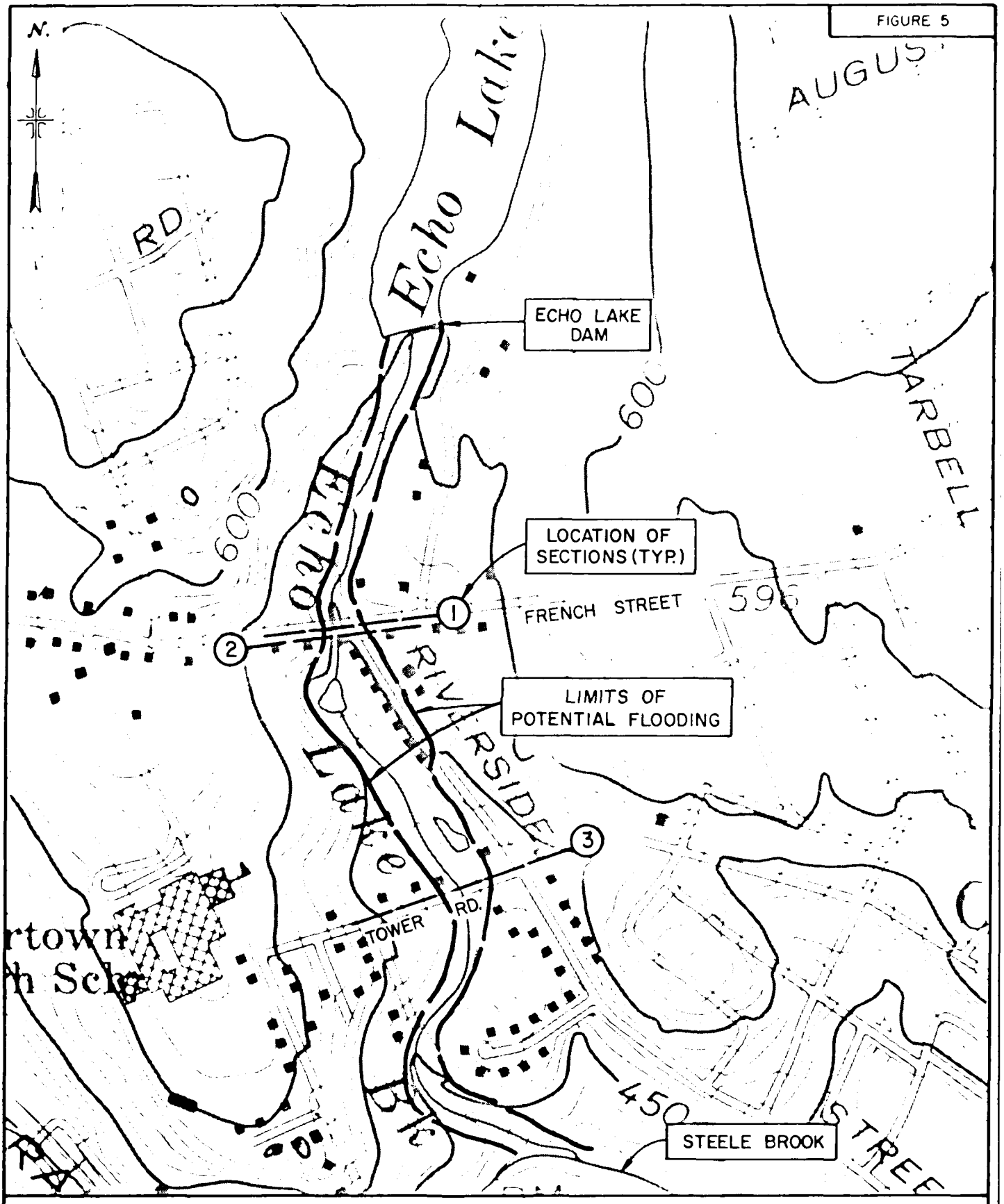
2) Watershed Area: Third = 12.37 sq in 4.07
First = 4.23 sq in 4.08
Start = 0.15 sq in

$$4.07\ in^2 \times \frac{(2000\ ft)^2}{in^2} \times \frac{1\ sq\ mi}{(5{,}280\ ft)^2} = 0.584\ sq\ mi$$

3) Contour 560: Third = 2.43 sq in 0.40
First = 1.64 sq in 0.40
Start = 1.24 sq in

$$0.4\ in^2 \times \frac{(2000\ ft)^2}{in^2} \times \frac{1\ acre}{43{,}560\ ft^2} = 36.7\ acres$$

FIGURE 5



LIMITS OF POTENTIAL FLOODING

ECHO LAKE DAM
WATERTOWN, CONNECTICUT
SCALE: 1" = 500'

ROALD HAESTAD, INC.

WATERBURY QUADRANGLE 1972

APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

DIVISION	STATE	COUNTY	CONGR. DIST.	STATE	COUNTY	CONGR. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
							ECHO LAKE DAM	4136.1	7305.9	17JUN80

POPULAR NAME	NAME OF IMPOUNDMENT
	ECHO LAKE

REGION BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	DIST FROM DAM (MI)	POPULATION
	ECHO LAKE BROOK	WATERTOWN	0	19600

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT)	HYDRAULIC HEIGHT (FT)	IMPOUNDING CAPACITIES MAXIMUM (ACRE FT)	IMPOUNDING CAPACITIES NORMAL (ACRE FT)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
		R	18	15	75	60	NED	N	N	N	N	

REMARKS

EMERGENCY SPILLWAY

SPILLWAY	MAXIMUM DISCHARGE (FT)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)
55		8665											

OWNER	ENGINEERING BY	CONSTRUCTION BY

REGULATORY AGENCY

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
	CT DEP	CT DEP	CT DEP

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION

REMARKS